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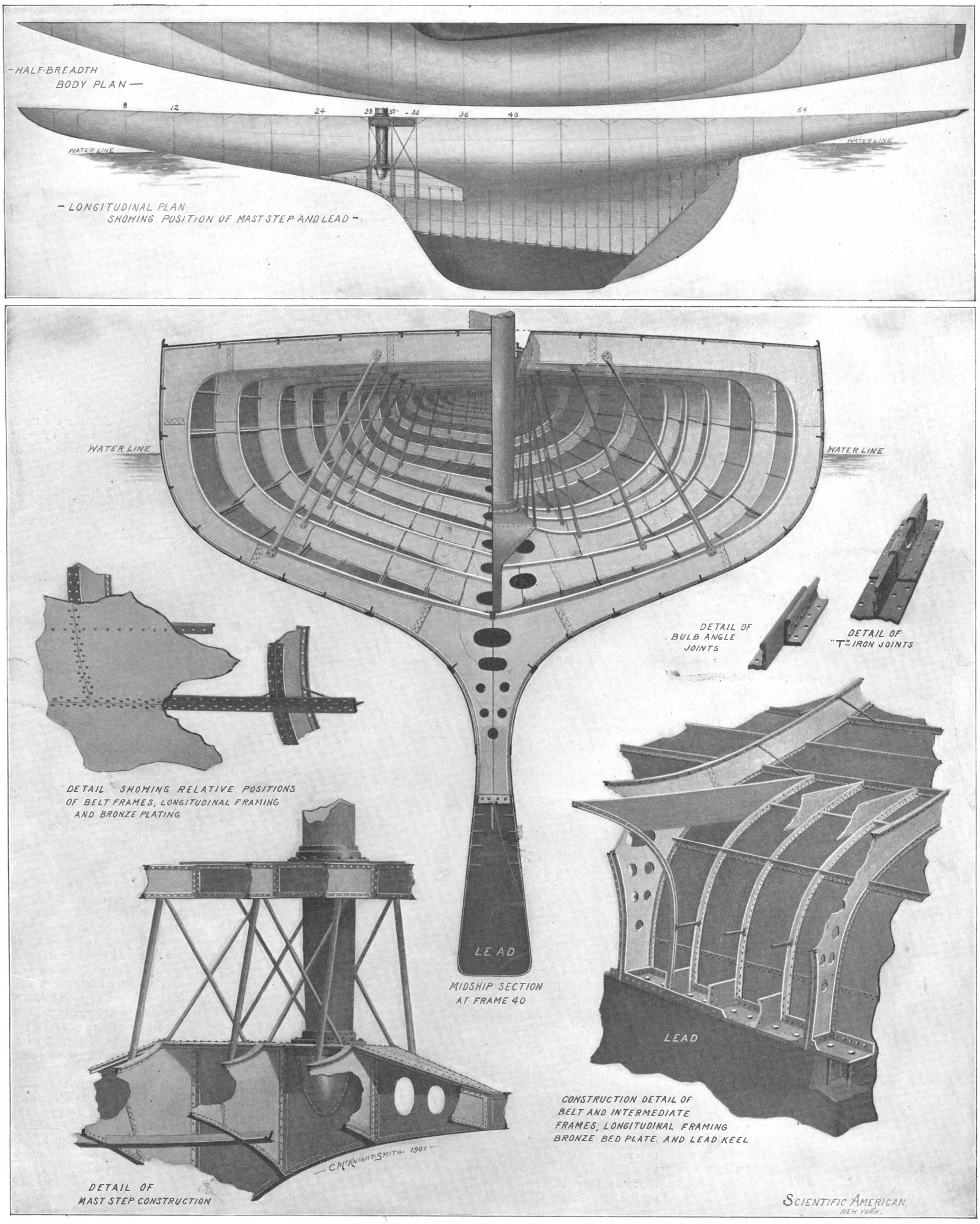

Length over all, 132 feet 6 inches; waterline length on normal draught, 89 feet 9 inches; extreme beam, 25 feet 2½ inches; normal draught, 19 feet 10 inches; sail area, subject to modification during trials, 14,400 square feet.

CONSTRUCTION OF THE CUP-YACHT "CONSTITUTION."—[See page 295.]

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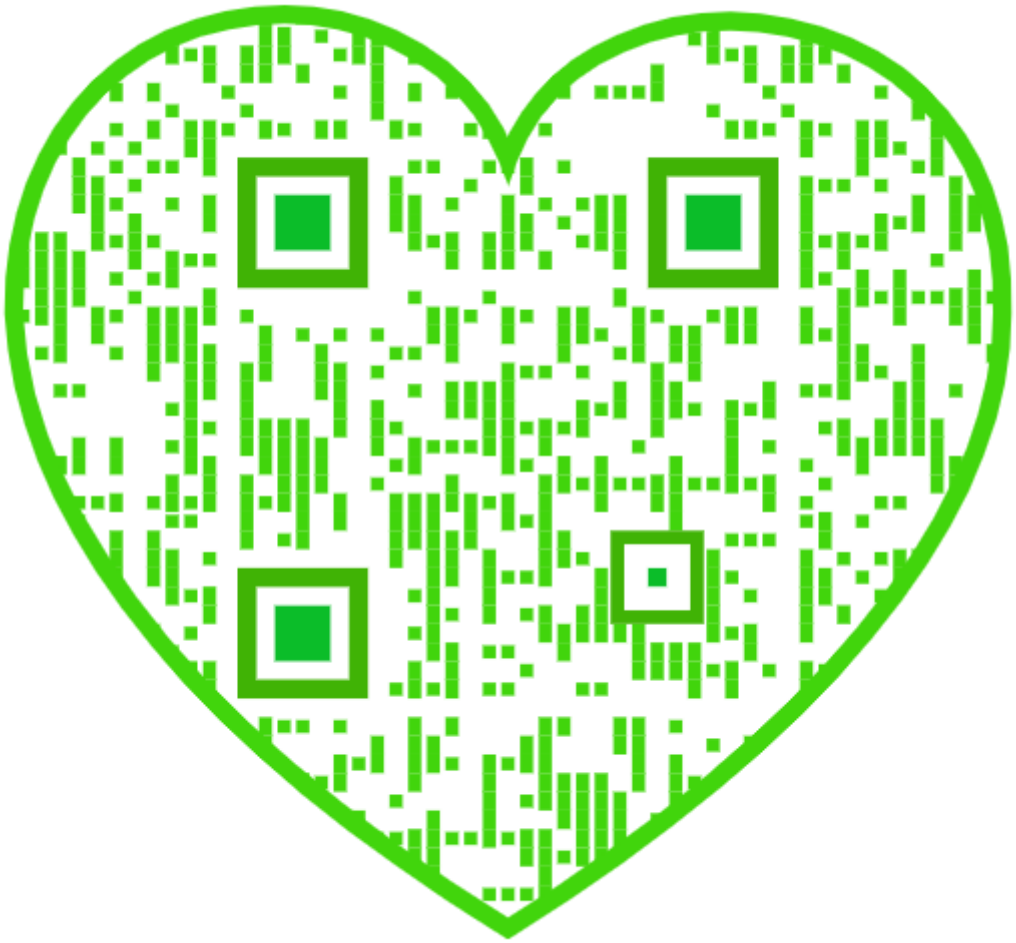

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NEW YORK, SATURDAY, MAY 11, 1901.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

CHICAGO DRAINAGE CANAL COMPLICATIONS.

In response to the request of the shipping interests of Chicago, the Secretary of War has given an order that the flow in the Chicago Drainage Canal must be reduced to 200,000 cubic feet per minute, which is about a third less than the discharge for which the canal was designed. When the construction of the canal was authorized by the Legislature, it was distinctly laid down that, when the sewage of Chicago was turned into the canal, it should be diluted at the rate of 20,000 cubic feet per minute for each 100,000 population, and that the total flow must not fall below 300,000 cubic feet per minute. These stipulations were made in agreement with the laws, and in response to the urgent representations of the residents of the valleys through which the sewage-laden waters of the canal would be carried to the sea, and it would surely seem as though the provision for a flow of 300,000 cubic feet per minute is surely none too ample in view of the unsavory burden that the canal waters carry. Unfortunately, the discharge of this volume of water produces a current which, it is claimed by the shipowners, is dangerous to navigation in the Chicago River. Moreover, the authorities of the city of Chicago are disposed to make much trouble over the question of canal bridges. Thus this magnificent enterprise would seem to be just now placed "between the devil and the deep sea."

It is not likely that any of these opposing interests would seriously deny that the drainage canal is a necessity, and that its completion and execution is one of the greatest sanitary works of this or any other age. That a large city like Chicago should continue to pour its refuse into Lake Michigan, with the prospect of ultimately bringing it into the absolutely disgusting condition which obtains to-day in Havana Harbor, is a proposition that neither the inhabitants of the Illinois and Desplaines valleys, nor even the city of St. Louis, would justify for a moment. Since the canal is there, and there to stay, it is surely possible, in such a reasonable age as this, for the contending interests to meet and consider the matter in a practical and broad-minded spirit, and make a compromise which shall do justice to every interest affected.

LIQUID AIR AS A BLASTING AGENT.

The problem of the exact field of usefulness of liquid air has been simplified by the elimination, for the present at least, of one class of work for which it was claimed that the new liquid would prove highly efficient. We refer to its use as a blasting agent. A paper recently read before the British Institution of Mining Engineers by Mr. A. Larsen described some tests recently made in the Simplon tunnel with cartridges, which consisted of a wrapper filled with a carbonaceous material, and placed bodily in liquid air until it was completely saturated. The cartridges were kept in the liquid, at the working face of the rock, until they were required for use, when they were lifted out, quickly placed in the shot-holes and detonated with a small guncotton primer and detonator. It was found that, owing to the rapid evaporation, the useful life of the charges was very short. The cartridges, which were 3 inches in diameter by 8 inches in length, had to be fired within fifteen minutes after being taken out of the liquid air; otherwise there was danger of a misfire. It was chiefly on this account that the tests were discontinued. The disruptive effects, however, were said to be comparable to those of dynamite.

TRAIN BRAKE RESULTS OF HIGH SPEED.

In our issue of April 27 we gave a synopsis of Behr's description of his high-speed monorail system, which it is proposed to build between Manchester and Liverpool, and on which it is expected that speeds of over one hundred miles an hour will be realized. It was mentioned that the important question of braking was to be solved by the use both of an electric and Westinghouse brake, and that calculations were based upon an estimate that the Westinghouse brake alone would enable the speed of the train to be reduced at the rate of three miles per second. Sir F. Bramwell, in a communication to the Journal of the Society of Arts, corroborates Mr. Behr's figures, and gives the results of tests carried out by himself and the late Mr. Cowper on the Midland Railway, in which it was proved that the speed of a train could be reduced at exactly the rate named, a train running at a rate of thirty miles a hour being brought to rest during these experiments without shock in ten seconds. Bramwell further suggests that it might be possible to utilize in high-speed trains a method of braking which is not dependent upon the weight of the train, and suggests the use of the "clip" brake, which, as the name implies, grips the sides of the rails in the same manner as the safety clutches used on many of the modern elevators grip the vertical guide-rails. The suggestion is a good one, for it would certainly seem that some form of clip brake would be necessary, at these high speeds, to secure an absolutely reliable and certain braking effect, whose power could be multiplied to any extent desired.

WATERWAYS AND CANALS OF CANADA.

The rivers and lakes of Canada, to say nothing of the splendid systems of canals by which they have been linked together, form a continuous inland water route which is unmatched in any other quarter of the globe. From the mouth of the St. Lawrence to the most westerly Canadian port on Lake Superior, a vessel may steam continuously in Canadian waters for a distance of 2,260 statute miles; while from Belle Isle to Montreal the St. Lawrence River offers a channel, large enough for the accommodation of ocean steamers, for a distance of nearly a thousand miles. The difference in level between Lake Superior and tidewater on the St. Lawrence near Montreal is 600 feet, and a vessel, in ascending from Montreal to Port Arthur, has to be lifted through this great vertical distance. Of this total 551 feet is covered by means of locks, and 49 feet of it are overcome by steaming against the stream, which, in some stretches of the river, is so strong that the vessels have to be assisted by tugs. According to figures furnished by J. L. Bittinger, consul-general, there are between Montreal and Kingston seven canals, with a total length of 50¼ miles, and a total lift at the locks of 207½ feet. The width of these locks is 45 feet, and the depth of water on the sills 14 feet. Steamers on the run down from Kingston make no use of several of these canals, for the reason that the rapids may be run with safety. From Kingston the westward course is through Lake Ontario to Port Dalhousie, where the Welland Canal commences. This structure is 26¾ miles in length, and the total lift of 326¾ feet is effected by twenty-seven locks, each 270 feet by 45 feet, with a depth of 14 feet. From Port Colborne, at the Lake Erie end of the canal, there is deep water for a distance of 394 miles to the Sault Canal, which is 5,967 feet in length, and contains a lock 900 feet by 60 feet, with a depth of 20 feet 3 inches, the total lift being 18 feet. Once through the Sault Canal the last natural obstruction is passed, and there is deep water to Port Arthur.

In addition to this magnificent system, Canada has another watercourse, which runs from Montreal to Ottawa, and then down to Kingston, a total distance of 245 miles. On this route there are four canals and locks: Lachine, St. Anne's, Carillon and Grenville. In the distance from Ottawa to Kingston, 126¼ miles, there are thirty-five locks. In addition to these main-line canals, moreover, there are other canals on the line of the Richelieu River, in Ontario, and through the Peterborough district in Cape Breton; and there are a number of branches connecting with the Rideau and Welland systems. The total traffic through the several canals in the Dominion, in 1889, amounted to 6,225,924 tons. The total quantity of through freight passed through the Welland and St. Lawrence Canals from Lake Erie to Montreal was, in 1890, 231,746 tons eastward and only 13,951 tons westward. In 1899 354,933 tons were passed eastward and only 5,991 tons westward. The total expenditure for the fiscal year ending June 30, 1900, was $3,351,164, and the total net revenue was $322,642. Commenting on this, the consul-general says that if it is judged by the net revenue received, as compared to the outlay, the Canadian canal system would be found wanting; but that the Canadians do not take so narrow a view of the question, and recognize that waterways and roadways are essential to the commercial life of the country.

TRANSPORTATION OF TRAINS ON LAKE BAIKAL.

The Bulletin of the Société des Ingenieurs Civils contains an account by M. Platon Yankowsky of the method of transporting the trains of the Trans-Siberian Railroad across Lake Baikal. The railroad is now in operation from Tcheliabinsk, on the eastern frontier of Siberia, to Stretiensk, on the river Chilka, an affluent of the Amour, on the frontier of Manchuria, making a total distance of 2,650 miles. The route is interrupted over a length of 40 miles by Lake Baikal, and the trains are ferried across the lake, in order to avoid going around it, which would increase the distance by 82 miles. It is expected that the route will ultimately follow the shore of the lake, but its exact position has not yet been decided. The piers for the ferry system have been built at a considerable distance from shore to assure a sufficient depth of water; the piers are united to the bank by causeways which have 1,800 and 1,100 feet length respectively. These piers are formed of wood caissons filled with stone, and each has the form of a fork, whose branches are of unequal dimensions, that next the lake measuring 486 feet long by 32 feet wide, and that next the shore 220 feet by 20 and 25 feet. The ice-breaking ferryboat "Baikal," used to transport the trains, enters the free space between the two branches, where it is protected from the waves. Upon the deck is let down a gang-plank which establishes communication between the rails of the piers and those of the boat, and the train passes upon the latter. The "Baikal," whose shell is of soft steel, measures 285 feet long by 56 feet maximum width, and the height from keel to the center of the main deck is 12 feet. When fully loaded, it has a draught of 19 feet forward and 17 feet aft; its displacement is 4,200 tons, including 580 tons water ballast and 250 tons of coal. It is driven by three screws, of which two are in the rear and one forward; the latter serves at the same time to disperse the ice which has been broken. These screws have four blades, the forward screw being of phosphor-bronze and the rear pair of steel. The former has a diameter of 12 feet and the latter 10 feet. The three triple-expansion engines give a total of 3,750 indicated horse power, and the steam is furnished by fifteen cylindrical boilers. With its three engines, the "Baikal" passes easily through compact ice two feet thick and more at a constant speed of about three knots an hour. Upon the deck are three tracks, which can receive 25 freight cars of a gross weight of 500 tons. Above the deck have been constructed cabins of three classes, which permit the transport of 200 passengers. Another ice-breaking boat, the "Angara," is used as an auxiliary for the transfer of passengers and for freight unloaded from the cars; she is also built of soft steel, and measures 197 by 34 feet, with 24 feet height at the center. Its draught at full load is 14 feet, and its displacement 1,200 tons. This boat, which has a capacity of 150 passengers, is driven by a single rear screw, and has a triple-expansion engine of 1,250 horse power. In smooth water each of these boats makes a speed of about 12.5 knots an hour. It is estimated that the total cost of the Lake Baikal transportation system reaches more than $3,400,000.

THORIUM COMPOUNDS.

In a paper lately read before the Académie des Sciences, Messrs. Matignon and Delépine give an account of a series of experiments which they have made upon two imperfectly known bodies, the hydride and the nitride of thorium. The nitride appears to have been discovered by Chydenius in 1863; he formed it by reacting upon the chloride with ammonia. M. Moissan obtained the same compound by the action of ammonia upon the carbonate. It has since been found that the metal will combine directly with nitrogen. As to the hydride of thorium, its existence has been demonstrated by Winkler. The experimenters purpose to make a further study of these two compounds, and to form them from the metal. To obtain thorium from its chloride by the method of Chydenius, the chloride was prepared by two methods; first by the action of well-dried oxide of carbon and chlorine upon the oxide of the metal heated in a porcelain tube, and second by the action of tetrachloride of carbon upon the oxide heated to redness in a glass tube. The first process gives a very pure product, but its action is slow, and the second is preferred, as it gives large quantities of the chloride, which, however, are less pure, and contain thoria in the form of oxychloride. The metal is prepared from the latter chloride by acting upon it with sodium; it contains a large proportion of thoria, being only 74 per cent pure. To form the hydride of thorium, the metal is heated to low redness, when it combines with hydrogen with incandescence, and forms a compound which is not decomposed by water. Hydrochloric acid attacks it, giving off hydrogen, which has double the volume of that given by the metal. By determining the proportion of hydrogen the formula for the hydride of thorium was found to be ThH_4. This body

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is easily decomposed; when heated in a small tube, in presence of air, an explosion takes place, due to the liberation of hydrogen, this being followed by the combustion of the metal. The second compound, the nitride of thorium, is formed by heating the metal to redness in an atmosphere of nitrogen; it corresponds to the formula Th_3N_4. Unlike the former body, it is not decomposed by heating in the air. Water decomposes it slowly when cold, but more rapidly warm, giving the reaction

$$Th_3N_4 + 6H_2O = 3TH_2 + 4NH_3.$$

These two compounds will burn in oxygen, but without giving the brilliant incandescence of the metal itself.

SOME FIGURES OF THE FIRST COST AND OPERATION OF SOUTHERN COTTON MILLS.

To make the assertion that cotton mills in the Southern States have increased from 10,000 to 5,000,000 spindles working in 485 mills in seventy years invites criticism from those who are unfamiliar with the development of the industry in this section of the United States. Yet, according to the most accurate calculations, mills containing the number referred to were either in operation or practically completed at the beginning of the new century. It should not be imagined that they are located in all parts of the South, for Florida has no mills whatever, but a half dozen are in the State of Texas, extensive as is its area, and Kentucky and Virginia have but a few, scattered here and there.

The principal activity in construction of cotton mills has been confined to the South Atlantic and Gulf States, beginning in the north in North Carolina and ending at the Mississippi River, although a beginning has been made in Arkansas, as well as Oklahoma and Indian Territories. An idea of the rapidity of construction can be gained when it is stated that the number of mills built in the South during 1900 was about 100, compared with 75 during the previous year. In 1895, according to best estimates, the number of mills was 325, representing 2,400,000 spindles. In 1897 the number had increased to 390, representing about 3,500,000 spindles. Here is shown a gain in five years alone of over 100 per cent. During the present year the number of plants projected is estimated to be somewhat less than in 1900, but the tendency in the South has been to increase the number of spindles and looms installed in a single mill, so that the total amount of machinery would practically be more than that erected during 1900.

The figures showing the cost of mill construction, etc., are significant. Those which follow are based upon actual estimates made of plants which have been constructed. The sum of $75,000 will build and equip a plant ready for operation containing from 3,000 to 4,500 spindles, according to the size of the yarn it is to produce. The sum of $100,000 is sufficient for a mill ranging from 4,000 to 6,000 spindles, while $175,000 will complete a 13,000-spindle plant. This price includes a brick and stone building, with heavy framework, containing fire protection, electric lights, steam heating, a water supply, also tenements for the necessary number of operatives, and warehouses for storing cotton. The $75,000 plant will consume between 50 and 60 bales of cotton a week, working on No. 8 yarn, or from 25 to 30, working on a finer product, No. 30, for example. In calculating these figures, an estimate of 15 per cent is allowed for waste of material by soiling, the amount taken out in going through the various processes, and the shrinkage. To operate such a mill with 6,000 spindles, 40 operatives are required for spinning alone. The labor is calculated to represent 15 per cent of the total cost of the product when coarse goods are made, the raw material 65 per cent, and the depreciation of the plant and other expenses the balance. The organization of a company operating a mill of 10,000 spindles and 320 looms generally consists of a president, who is also the treasurer, a secretary and a superintendent. These three form the executive heads of the various departments, the secretary acting as bookkeeper. No large salaries are paid, that of the president sometimes being as low as $2,500, while the superintendent receives from $1,500 to $2,000, and the secretary $1,200 to $1,600. The salaries, of course, increase in proportion to the size of the mill; the president of a plant of from 75,000 to 100,000 spindles may receive from $12,000 to $15,000 annually, the secretary $2,500, and the superintendent, who may have an assistant, $5,000. The cost for power, of course, varies, but upon averages secured from a number of mills in various portions of the South, operated under different conditions, steam costs per horse power per year from $12.50 to $17.50. Water power varies from $7.50 to $15 where the power is applied directly to the machinery and not used for electrical generation. It is calculated that between six and eight tons of coal per day are sufficient to operate a 400 horse power engine during eleven hours of continuous service. About one and one-half cords of pine wood are equal to one ton of coal.

The use of electricity generated by water or steam power is becoming more and more popular with Southern mill owners. Calculations have been made showing that the installation of motors in various departments, so that one section of the machinery can be operated independently of another, is much more economical than when power is communicated by shafting and belting, which requires possibly half or all of the mill equipment to be run in order to operate a certain portion. The Columbia Manufacturing Company, at Columbia, S. C., recently constructed an extensive plant for the manufacture of heavy duck. A set of turbines located on the Columbia Power Canal supply the sources of power from a series of large dynamos, and the current is conveyed to motors in each department. In turn, the machinery in the departments is divided into sections, each connected with its individual motor. Thus a section of looms can be placed in operation, while the rest of the plant is idle, if desired. The Pelzer mill, at Pelzer, S. C., containing the largest number of spindles under one roof of any plant in the world, is also operated by electricity, distributed upon the same plan. It has been argued that even where steam is depended upon solely, electric transmission is from 20 to 30 per cent cheaper in the long run.

Houses for the operatives are usually constructed of wood, and in the larger mill villages have from six to ten rooms each. If the company installs gas or electric lights and water works, they are furnished with these conveniences, also baths. A six-room house costs, on an average, $600, or $100 a room. The same is true of the larger houses. A six-room house will rent at from $10 to $12 a month, or 25 per cent of its total cost. Estimating interest on investment, "wear and tear" and taxes at 10 per cent of the rental, a profit to the company is left of 15 per cent yearly. The scale of wages naturally varies according to the character of the goods produced. An estimate taken from the daily pay roll of a North Carolina mill gives $13.50 for fifty-four hands. They include one spinner at $1.50, six boys in various capacities from 75 cents to 40 cents, and twelve girls at 26 cents each. This group includes every department of the mill, from picking the cotton to the spinning. Yet at this scale of wages, little difficulty has thus far been encountered to obtain enough labor, as the operatives, on the average, live much better and suffer less hardships than when earning a livelihood in the mountains.

The above are some of the reasons why cotton manufacturing in the South has so rapidly revived on account of the profits which have accrued to the manufacturers. The combination of advantages which they have enjoyed has enabled not a few of the companies to earn enough to declare, if they desired, an average dividend of from 10 to 15 per cent annually, after allowing from 8 to 10 per cent for depreciation of machinery and buildings. Few such dividends are announced, however, as it has been the general policy of late years to add to the surplus, making it a fund for enlargements and betterments. This is why quite a number of the Carolina mills have doubled their capacity within the last ten years, paying entirely for the enlargements out of the profits of the original plant. A number of illustrations might be cited of this kind. One mill located at Gaffney, S. C., earned 22 per cent yearly for the first three years it was in operation, and its machinery was operated 22 hours out of the 24 during the first two years. It manufactured a certain grade of sheeting, and during the period mentioned actually controlled the price of the American market. Instances are also known of mills which have cleared as high as 30 per cent in a year upon their capital stock, or enough to give stockholders a dividend of 20 per cent, after allowing for wear and tear and new machinery. These figures include income from all sources, including the rental of property owned by the company.

The inducements to construct mills have resulted in possibly a score of small plants being built on the installment plan. In the vicinity of Gastonia, N. C., are several of this character, in which the operatives are also stockholders. For instance, a $100,000 company would be organized, divided into 1,000 shares of $100 each, each shareholder being allowed to pay at the rate of fifty cents to $2 per week per share, the idea being to have the stock fully paid up at the end of two or three years. As soon as $25,000, or enough had been accumulated to start work, contracts would be let for a certain portion of the mill building. Possibly it would be finished off and a small amount of machinery installed and started, the balance of the machinery being added as subscriptions were made to the capital stock. Thus employes were actually helping to pay for the plant out of the proceeds of the wages received from the company. The plan followed is quite similar to that pursued by building and loan associations.

At present the mills in the South are manufacturing 17 per cent of the cotton produced in the United States, which represents nearly 70 per cent of the world's production. The home consumption of Southern cotton is rapidly increasing, as might be imagined from the activity in mill building, and calculations have been made that at the present rate of progress fully 5,000,000 bales will be converted into yarn and cloth in 1901 by the plants in the section referred to, or three times the present amount.

SCIENCE NOTES.

Prince Luigi of the Abruzzi has been presented with the citizenship of Rome.

Capt. Bernier, whose scheme to organize an expedition for the discovery of the North Pole is now before the Canadian government, has received a letter from Lord Minto, the Governor-General, stating that he has much pleasure in publicly becoming a patron of the Arctic exploration scheme.

A strange phenomenon was recently witnessed in Southern Italy and Sicily. This was a heavy red cloud which extended over this territory, and the rain resembled drops of coagulated blood. This phenomenon, which is called "bloody rain," is attributed to dust from the African deserts transported by heavy south winds.

Germany proposes to forbid the employment of saccharine and other sweetening matter, except when it is recommended for therapeutic purposes. The sale of the substance will be permitted only by chemists and other specially authorized persons. Even in these instances it will be subjected to a consumption tax of $20 per kilogramme. This new law will go into effect in April, 1902.

The great dinosaur, the restoration of which has been the work of the Geological Department of Yale University for more than a year, has been placed in position in the Peabody Museum at Yale. It was discovered by Prof. J. B. Hatcher in the summer of 1891 while exploring for the late Prof. O. C. Marsh of Yale in Wyoming. The specimen was in excellent condition with all its parts intact, and it was also an entirely new variety. There is but one other specimen in the world, and this is in Brussels; its length is 29 feet 3 inches. The height of the head above the base is 13 feet 2 inches.

The indigo industry of Bengal is suffering severely from the competition of the manufactured German dye, huge quantities of which are being exported to India and the other markets hitherto controlled by the Indian industry. The German synthetic indigo is considered to be superior and is much cheaper. It is also stated that if the native indigo manufacturers were to conduct their work upon a more scientific basis, and were to extract the maximum quantity of dye from each plant, they would be in a position to meet the German competition. With a view to encouraging the industry, the government of Bengal has voted $22,500 for research work, with a view to facilitating and improving the existent process of manufacture.

Samarium oxide, according to Mr. Henri Moissan, at the temperature of the electric furnace, and in presence of carbon, forms a crystallized carbide of formula $Sa C_2$. The composition of this carbide is comparable with that of the carbide of cerium, lanthanum, neodymium, and praseodymium. It decomposes cold water in the same way as the carbide of the alkaline earths, giving a complex mixture of hydrocarbons, very rich in acetylene. It has a density of 5.86, a yellow color, and when examined under the microscope has a crystalline appearance—the particles having a hexagonal shape. This substance burns brilliantly at 400 deg. in a current of oxygen. The decomposition of water by the carbide brings the metal samarium near to the yttrium group, and removes it farther from the rare earths belonging to the cerium group.

A Parisian professor suggests a certain treatment of silk for enhancing its hygienic value. The process consists in combining gun cotton with silk or wool by impregnating either of them with a solution of collodion or a solution of celluloid. The dissolvent used may be either (preferably Hoffmann's) amyl acetate, acetone, or methylic alcohol. A solution is made consisting of one part of gun cotton (octonitric cellulose) or of celluloid in 100 parts of Hoffmann's ether (a mixture of alcohol and sulphuric ether), or any other suitable solvent. Or one part of tetracetate of cellulose may be dissolved in 100 parts of nitrobenzene. (The proportions are by weight.) Either of the above solutions forms the required "dressing" to be applied to the material. The material to be treated is made into a roll either of a loose fibrous material or as a fabric, according to the purpose for which it is designed. This roll is immersed in a cylinder filled with the solution. The roll is turned round several times in this bath, and the cylinder is then emptied by means of a tap provided for that purpose. The material is taken out, unrolled and left to dry.

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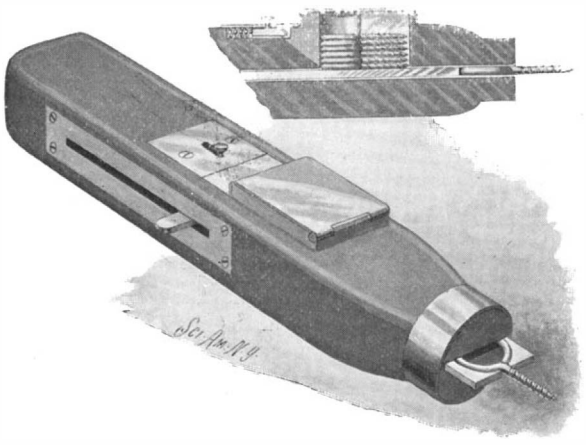
A TOOL FOR DRIVING SCREW-EYES.

The subject of the illustration presented herewith is an ingenious tool for driving screw-eyes patented by Edmund Sather, of 16 Second Place, Brooklyn, New York city.

The tool has a two-part body which serves as a handle and contains a magazine for screw-eyes, open at its bottom and provided with a hinged cover for its top. Beneath the magazine a carrier slides by which the screw-eyes are conveyed to the end of the tool, the carrier for that purpose being provided with an opening to receive the head and shank of a screw-eye. The carrier is shifted back and forth by means of an arm projecting through a slot in the handle. Adjacent to the slot a latch-lever is pivoted, having an



A TOOL FOR DRIVING SCREW-EYES

inclined head and an offset, both of which are adapted to be engaged by the arm of the carrier.

In using the device, the carrier is brought directly beneath the magazine to receive a screw-eye. The projecting arm is forced to the front end of the tool until it has passed the offset of the latch-lever and bears against the forward end of the offset. At this time the carrier will have reached the front of the body; and the shank of the screw-eye will project beyond the forward end of the handle, as shown in our sectional view. The screw-eye can now be driven into position into places which would otherwise be reached with difficulty. The tool can easily be withdrawn from the screw-eye by taking the carrier a sufficient distance beyond the front end of the handle to expose the head of the screw-eye by turning the tool to one side to disengage the carrier.

In driving a screw-eye in a wall, the head of the screw-eye is within the casing and the carrier-arm is in front of the latch-lever offset, so that the necessary pressure to be exerted on the screw portion of the eye will not move the carrier-arm. When the eye has been screwed in, the arm is shifted forward, forcing the inclined head of the latch-lever to one side against the pressure of a spring, whereupon the carrier and screw-eye are correspondingly brought forward, as shown in our perspective view. By turning the tool, the carrier and eye are disengaged.

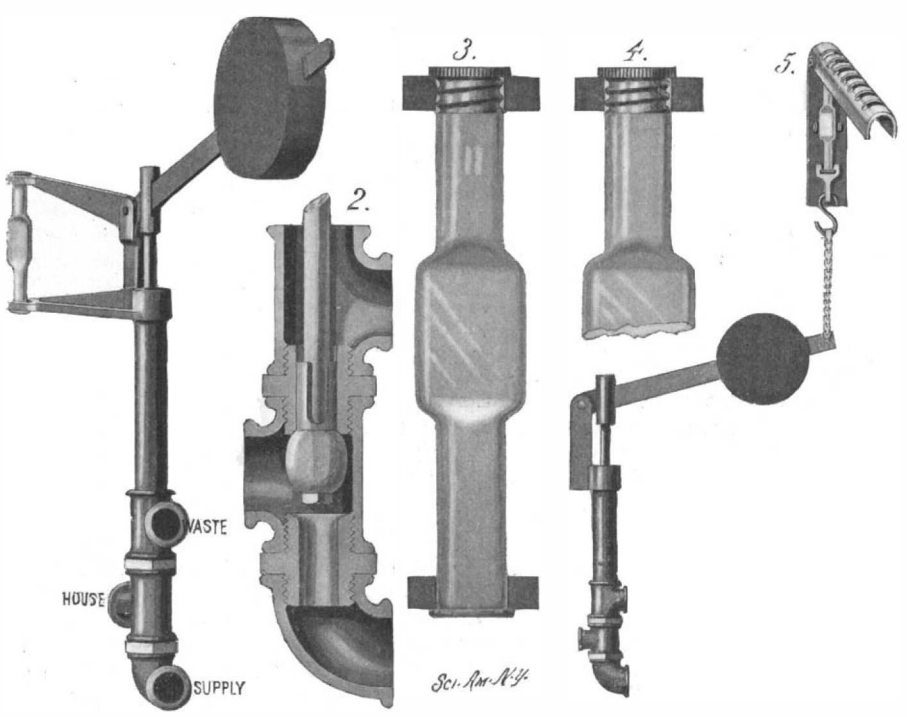
AUTOMATIC FROST VALVE FOR WATER-PIPES

One of the simplest devices which we have yet seen for preventing the bursting of water-pipes during cold weather is a combination which includes a fragile cartridge readily broken by the expansive force of freezing water and an automatic valve mechanism. The device is the invention of Mr. Daniel W. Troy, of Montgomery, Ala., and has demonstrated its usefulness in actual work. Indeed, the success of the system has been such that the manufacture of the cartridges and valves has been undertaken on a large scale.

The cartridge itself is a small glass vial, flattened centrally (Fig. 3) and provided with a flanged foot, and with a flanged, cork-lined screw-cap. The water-filled cartridge is held between the U-shaped jaws (Fig. 1) of a weighted lever, which bears on a valve stem. The valve (Fig. 2) is essentially a ball, which, when depressed, closes the supply-pipe and opens the waste-pipe. Although strong enough to uphold the weighted lever, the cartridge is nevertheless weak enough to break at its flattened central portion when the water contained therein freezes. (Fig. 4.)

From this brief description and our illustration the operation is evident. During ordinary weather the cartridge will distend the jaws to hold the weighted lever up and to maintain the valve in its nominal raised position, in which water can readily flow from the supply to the service-pipes of the house. When the weather becomes so cold that the water-pipes are in danger of bursting, the expansive force of the freezing water in the cartridge will burst the central flattened portion, thereby causing the weighted lever to fall and the ball-valve to descend and close the supply and simultaneously open the waste-pipe. The insertion of a new cartridge is simple enough. The valve portion can be safely buried in the ground at any desired depth, the cartridge being located at the surface and exposed to the cold.

A modification of the invention is shown in Fig. 5, in which the cartridge is shown held in a special holder having a fixed U-shaped jaw and a similar movable jaw from which the lever is supported by a chain. The holder can be screwed on a wall. A ventilated cover protects the cartridge. The valve can be located in the cellar and the cartridge and holder in any convenient exposed place.



GLASS CARTRIDGE AND AUTOMATIC VALVE TO PREVENT THE BURSTING OF WATER-PIPES.

Velocity of Earthquake Waves.

The earthquake waves due to the Japanese shock of June 15, 1896, were recorded on the self-registering tide-gages at Honolulu, Hawaii, and at Saucelito, in the bay of San Francisco, California. The center of the shock was located, from Japanese observations, about 240 kilometers southeast of Mikayo at a depth of 4,000 fathoms, and the time of the shock is known. The usual formula for calculating the speed of such waves is $v =$ square root of $g.h$ where v is the speed, g a known constant and h the depth of the ocean assumed to be constant. Dr. Charles Davison has recently compared the calculated velocity of the earthquake waves with the velocity calculated from the foregoing formula. At Saucelito, for example, the first crest of the waves reached the tide gage ten hours and thirty-four minutes after the shock, having traversed in this time the distance of 4,787 miles at an average velocity of 664 feet per second. The formula gives the mean depth of the ocean in the track of the wave as 13,778 feet. The actual depth is certainly more than 17,000 feet, so that the calculated is only some four-fifths of the observed value. A corresponding result was reached in the discussion of another shock, so that for the present it is necessary to correct the accepted formula by multiplying its result by the constant multiplier 5-4. Other discussions of this character are much needed.

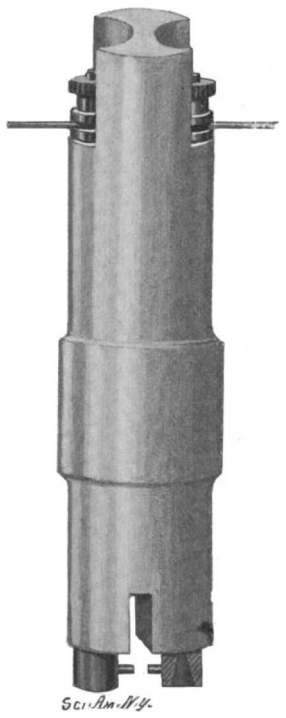
Traffic on Great Eastern Railway.

At the International Congress of Railroads, M. Drury, one of the chief officials of the Great Eastern Railway, brought out some interesting figures relating to the suburban traffic in London from the Liverpool Street station, which is the head of the system and located near the Bank of England. This station has 18 tracks. According to notes made during the day of October 9 the total number of passengers, counting those going each way, amounted to more than 150,000. The greatest number of trains entering the station in one hour was 41. The number of trains entering or leaving the station during 24 hours exceeded 1,100. On week-days about 75,000 passengers came in, of which 52,000 were between 6 and 10 A. M. The suburban trains are generally made up of 15 cars, and take about 650 passengers; they include first-class compartments of 8 places each, and second and third-class of 10 places each. The company has lately adopted a type of large cars, and these have given very satisfactory results; the new cars have first and second-class compartments, the latter having 12 places. The average speed of the suburban trains is 15 to 21 miles an hour, and the suburban traffic is provided for by 1,300 to 1,400 passenger cars and 120 locomotives.

A NEW IGNITER FOR EXPLOSION-ENGINES.

The tendency of the ordinary gas engine igniters to spark where sparking should not occur is only too frequently evinced. An intelligent attempt to obviate the difficulty is to be found in an invention for which William Roche, of 42 Vesey Street, New York city, has taken out a patent.

The body of the new igniter is made of porcelain and is provided at the end fitting into the explosion chamber of the cylinder with a central notch, forming two distinct lugs or projections. Extending from the lugs through the body are divergent passages for the reception of wires, the inner ends of which fit into tapering openings in the conducting caps which carry the platinum spark points, and the outer ends of which are threaded to receive nuts. The nuts are located in segmental recesses separated by an insulating partition and serve the purpose of forcing the conductor caps against the lugs of the porcelain body.



THE ROCHE IGNITER FOR EXPLOSION-ENGINES.

By reason of the divergent arrangement of the conductors. their inner ends will be close to each other, so that there is small danger of the production of sparks within the body. The insulating partition between the segmental recesses of the outer end of the body prevents the passage of sparks between the adjacent edges of the nuts. The central notch which forms the lugs of the inner end of the body prevents the bridging of the space between the two caps by the electrical deposition of matter on the lugs.

Igniters have invariably been made with the insulating center piece flush with the metallic receptacle, for which reason bridging occurred internally only too often. When the porcelain broke down or ceased to retain the high insulating qualities it should possess, the receptacle as well as the insulator had to be thrown away. When the porcelain in the Roche igniter breaks down, the old porcelain can be taken out and the new one set in without removing the receptacle.

Electric Railways of Canada.

The statistician of Canada has compiled some interesting figures regarding the 34 electric railways of the Dominion. During the year ended Dec. 31. 1899, 630 miles of tracks were used and the total number of miles run by cars was 29,646,847. Passengers carried numbered 104,033,659, which was equal to carrying every man, woman and child in the Dominion 20 times. Compared with the previous year, the number of passengers increased nearly 9,500,000, and the number of miles run over 1,000,000. The amount of paid-up capital invested in electric railways is $21,700,000.

Ammonium Amalgam.

According to Nature, the much-debated question of the existence of an ammonium amalgam appears to be finally settled in the affirmative as the result of recent researches. The investigation of the electrolytic tension of decomposition of the ammonium salts with a mercury cathode, by Coehn and Dannenberg (Zeitschrift für anorganische Chemie) has given results perfectly analogous to those obtained with salts of the alkali metals, and experiments carried out under varying conditions, to ascertain the possibility of reducing the heavy metals from their solutions, show that the negative results previously obtained are due to the great instability of the ammonium amalgam. By preparing the amalgam electrolytically at low temperature (0° C.) it appears to be much more stable and does not exhibit, to any great extent, the spongy appearance peculiar to the amalgam prepared under ordinary conditions; if then allowed to act on cold solutions of copper, cadmium and zinc salts, the formation of the corresponding heavy metal amalgams is easily observed.

The first cargo of Russian pig iron has been dispatched to Marseilles. The cost of the transport by sea from the port of Kertch is very low.

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THE LAUNCH OF "SHAMROCK II."

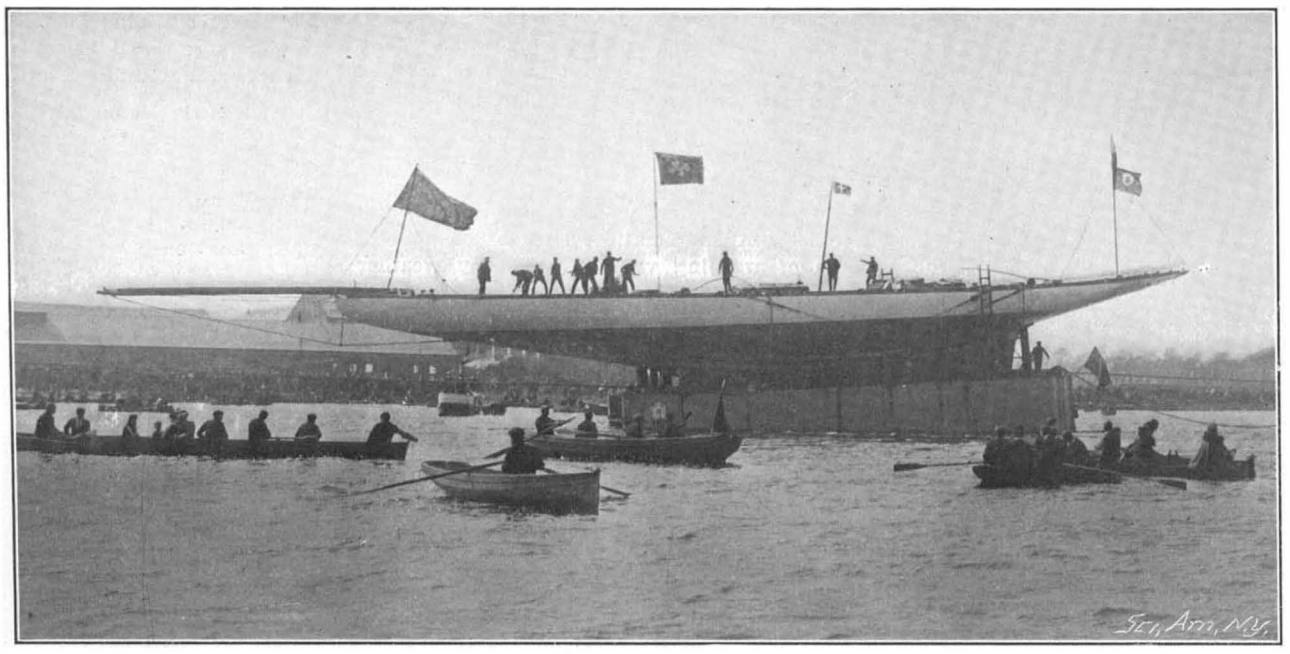
In the contest for the "America" cup the present holders have very wisely preserved each successful defender as far as possible unaltered to act as a trial horse with that which succeeded. In Britain, where there has been a variety of challengers, and an occasional change even in the designer, this course has been impossible, and the challengers' chances of success have always suffered from the fact that each succeeding boat was practically an independent experiment. In the yacht which was launched at Dumbarton on Saturday a change has been made for the better, for she represents the first real attempt of either side to produce a cup racer on lines governed entirely by scientific experiments.

Before definitely deciding to accept Sir Thomas Lipton's commission to design an "America" cup challenger, Mr. G. L. Watson entered into correspondence with Messrs. Denny Brothers, of Dumbarton, who rank as the most scientific of Scottish shipbuilders, and arranged with them for the carrying out of an exhaustive series of experiments in their test tank, which has a length of 200 feet, and is one of the most perfectly equipped testing tanks in Britain. These experiments were started in June, 1900, and proceeded for fully nine months before Mr. Watson was satisfied that he had sufficient data to justify him in proceeding with the designing of a cup racer. There were no less than eleven different models made, and sixty different modifications of these models were tried in the course of the experiments. Mr. William Fife, Jr., designer of "Shamrock I.," lent a willing hand in this part of the work, and the result is that it was possible to test absolutely accurate models of "Shamrock I." and "Valkyrie III." one against the other, and to experiment fully with modifications of the model of each of these boats.

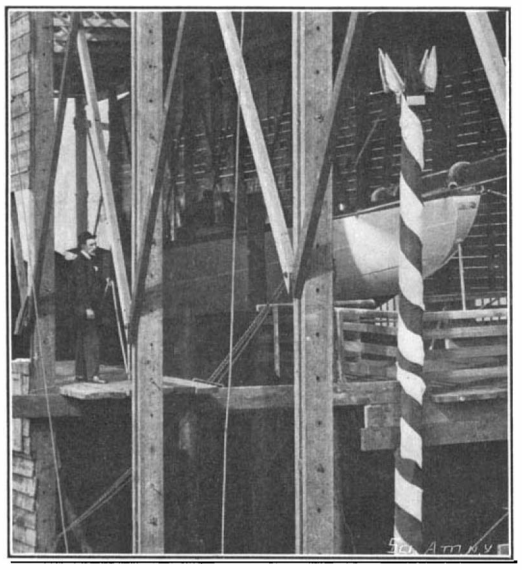
How far the result of these test tank experiments can be made applicable to the conditions of actual racing remains to be seen, but there can be no question that Mr. Watson has introduced a feature of much importance and one that promises to make the British boat a more formidable opponent than has ever been brought against an American defender of the cup.

So far as the general characteristics go, "Shamrock II." is a boat of the ordinary type, with a shallow canoe-like body, steadied by a deep bulbed keel under water and drawn out into long, sharp ends above. In the little information which leaked out regarding the result of the experiments in the test tank, it was hinted that the new boat would be found to throw back, to some extent, to the old "cod-head and mackerel-tail" type, favored by the designers who worked before any attempt had been made to wed mathematics and yacht designing. There is some truth in this suggestion, so far as it concerns that part of the yacht which is above water; for the bow lines of the new challenger carry the beam of the boat further into the forward overhang than has been the case in any racing yacht ever built on the British side. In the afterbody, also, the description is justified to some extent, for the quarters and the counter are drawn to a finer point than has ever been attempted in a yacht of this size on either side of the Atlantic.

The point of extreme beam, which is forward of the mast, has a width which is certainly not under 24 feet, and is probably fully 25, but the drawing in of the afterbody has been so thoroughly done that the long counter is tipped with a taffrail which measures not more than six or seven feet across. The American boats have generally been fuller in the bow than those built upon the British side, so that in one way "Shamrock II." may be said to be coming to American ideas—and carrying them even further; but the fining of the after section is a matter which is only being experimented with and has never been carried to anything like this extent in a cup racer. To the eye trained to the ordinary type, it looks as though the new challenger may be lacking in power in the afterbody, but it is unlikely that Watson adopted a change of this nature without first assuring himself of its value.



"Shamrock II." Afloat in Her Launching Pontoons.



View in Construction Shed, showing the Snubbed-off Bow.

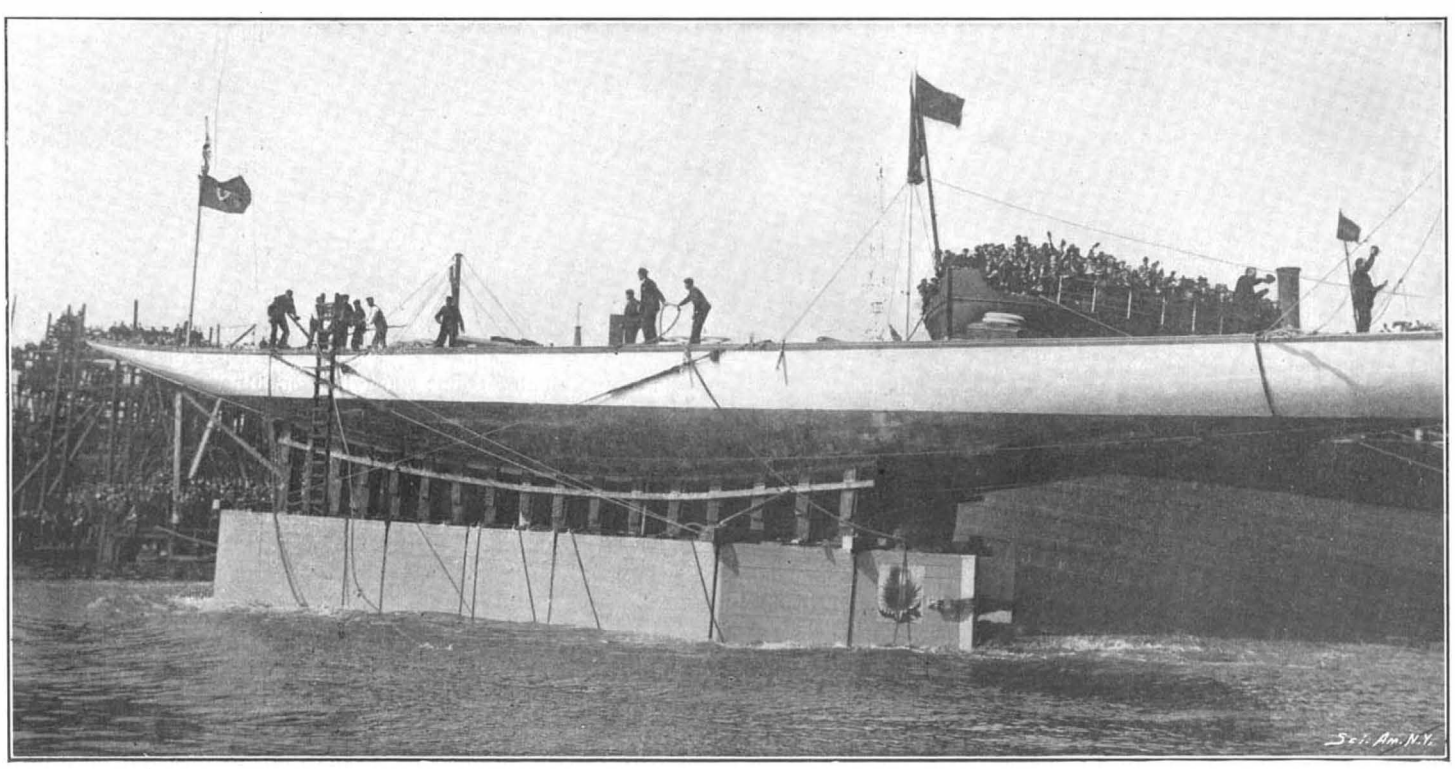
These are the most striking characteristics of "Shamrock II.," but there are other features less noticeable, but still well worthy of attention. The under side of the forward overhang is beautifully formed, with sections which give almost perfect segments of a circle. Under the bow, the shape is exactly that of the forward end of a soup spoon, and this shape, together with the great beam, gives the impression of a yacht which has little danger of developing the great fault of "Shamrock I."—that of burying her head when hard pressed.

In her sections the yacht is noteworthy chiefly for the easy curves of bilges and garboards. She is very much easier in this respect than Sir Thomas Lipton's last cup challenger, and she is easier even than "Columbia." The floor has a fair amount of dead rise, and the turn where the fin and the hull join is also sweet and easy. In drawing the big deck plan down into the small underbody there was a danger of making some hard and awkward turnings, but this has been successfully avoided, and the yacht shows fair, true lines of much beauty. Over all, the yacht tapes about 135 feet, and the waterline length is within an inch or two of the allowable limit of 90 feet. The draught is about 19 feet. The casing of the hull is carried right down to the point of extreme draught of the fin, and the lead is run inside, the construction being similar to that of "Independence."

The framing of the boat is of bulb nickel steel, and the plating from keel to rail is in manganese bronze. There will be experimenting with the spars before the cup-racing trim is finally settled upon; but the mast, which was stepped immediately after the launch, is a hollow steel spar, built in such a manner as to allow of a wooden topmast telescoping inside. The boom and gaff are also of the same construction, and lightness has been pushed so far that the gaff is built of plates only 3-16 of an inch in thickness. To save weight and for convenience of construction the bow has been snubbed off, giving it the peculiar appearance shown in our view taken before the launch.

The shallowness of the water on the Leven made it impossible to launch the boat in the usual way, and large pontoons were therefore built on each side of the yacht for the purpose of floating her over the shallows. Incidentally, they had the effect of concealing a large part of the underbody of the yacht when she went down the ways. Supported on these, the yacht was floated at ten feet above her normal waterline, and she was got out of the Leven and taken to Glasgow with little difficulty.

She is announced by British experts to be undoubtedly the most beautifully-lined challenger that has ever been built, and, though there is a possibility that she may sail a little tender in fresh winds, the hull carries with it the suggestion that she will be a dangerous opponent in anything less than moderate winds.



View from off the Starboard Bow, showing the Easy Bilge and the Great Breadth of the Forward Sections.

THE LAUNCH OF "SHAMROCK II."

The New York Central Railroad is trying a car-kitchen on the Empire State Express. Owing to the great speed at which the train is run, it is not thought desirable to add a dining car. A portion of one of the coaches has been equipped with a small kitchen similar to those used on the regular dining cars.

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Correspondence.

Early Iron Ships.

To the Editor of the SCIENTIFIC AMERICAN:

In looking over some old numbers of your paper, I came upon the letter of Mr. William Owen in the issue of December 1, 1900. No doubt his dates are correct as to the iron ships he mentions. I wish, however, to add to his list a statement of an earlier date of an iron ship which went from the Atlantic to the Pacific Ocean.

In 1850 I went from New York to San Francisco in the iron bark "Polk," then in the service of the United States government, sailing in the revenue cutter service, under the Treasury Department.

Her hull was wholly of iron, with wooden spars. My recollection is she was built at Richmond, to try some new-fangled wheels which were not successful. It was then proposed to convert the hull into a light vessel for the Sow and Pigs Shoal.

But Lieut. John McGowan, father of Capt. McGowan, now in the navy, said he could take her to California, and after a good deal of opposition he was allowed to try the experiment. We sailed from New York early in March, 1850, and arrived at San Francisco in August, after a passage of one hundred and fifty-eight days, all hands in good health.

I think this date may be given as the earliest of any passage of an iron vessel from the Atlantic Ocean, around Cape Horn, to the Pacific Ocean.

So far as I know, I am the only survivor of those who sailed in the wardroom, of whom I now remember the names of about a dozen.

CHARLES H. ROCKWELL.

Tarrytown, N. Y., April 15, 1901.

The Locomotive of the Future.

To the Editor of the SCIENTIFIC AMERICAN:

I have just read with great pleasure your article on "The Locomotive of the Future," in the SCIENTIFIC AMERICAN of April 27. My business leads me to have more or less to do with locomotive engineering, and as I read your article one or two statements struck my fancy, and I wish you would explain them more fully to me.

First.—How will you get 110,000 pounds on each set of coupled drivers? This weight, added to the weight carried by two four-wheeled trucks, would bring the weight of the tender to about 130,000 pounds, reckoning low. Since the weight of a tender now seldom exceeds 40,000 pounds, the engines, by your calculations, would weigh about 90,000 pounds.

Second.—You noted Sturrock's engine of 1855. His engine, as you may know, carried engines on both the locomotive proper and the tender. By this means the tender propelled itself. In the engine of your description the tender propels itself, but the dead weight of the boiler, firebox and frames must be brought into account.

I think that your plan is excellent to a certain extent, but I think that you would be able to produce too much power for the tractive power of your engines.

I believe that the most feasible way to increase the heating surface will be to lengthen the boiler. This can be done to quite an extent, and will certainly increase the economy of coal consumption, as more heat will be absorbed from the gases during their longer flow through the tubes. W. EMORY WARDNELL.

Worcester, Mass., May 2, 1901.

[Our correspondent evidently considers that the adhesive weight would be too small for the power of the engines; but the transfer of the engines, drivers and heavy framing to the tender, together with the great increase in the bulk of the tender itself, to say nothing of its fuel and water, would be found to provide the necessary adhesive weight.—Ed.]

Work on the Cairo-Cape Telegraph.

The work of constructing the Cairo-Cape telegraph line is being actively carried on, and keeps pace with the construction of the railroad from Mombassa to Victoria Nyanza. At the end of last year the length of this part of the line reached 480 miles. The wire used in the construction weighs 650 pounds per mile. Between Mombassa and Nairobi, a distance of about 310 miles, the communication is made by three wires, and after the latter point two wires are used. About 45 intermediate stations have been opened for communication. Between Railhead and Port Florence, the terminal station of the Victoria Nyanza section, a temporary line has been constructed, but from Port Florence to Eutebbe, the capital of the Uganda protectorate, the line is in a completed state, or nearly so. Instead of cut poles, living trees, the branches of which are cut off, are planted along the line. Experience has shown that the living trees are not attacked by white ants like the poles. These trees take root easily, and only need to have the branches cut off from time to time. The wires are fixed simply by well-tarred hemp cords, which take the place of insulators. The trees will be replaced later on by iron poles, as has already been done over a part of the system.

Electrical Notes.

A full length marble statue of Dr. William Gilbert, the father of electrical science and author of "De Magnete," is to be erected at the instance of the members of the medical profession at Colchester, his old home.

The dielectric strength of ice increases with a falling temperature, and is more particularly effective against intermittent currents or those alternating at high rates. Tesla suggests inserting a transformer in a freezing jar, and has patented a system of underground conductors where the two mains are the flow and return pipes which carry a cooling material, the pipes themselves being buried in wet cement or water, in a trough.

Consul-General Guenther, of Frankfort, on February 23, 1901, writes: An automatic system of signals for the purpose of warning vessels in stormy weather against the proximity of reefs and rocks has been exhibited to German marine experts. The automatic part of the apparatus is said to consist of a wheel with a number of cogs arranged at suitable intervals, which slide over a Morse apparatus. The latter is connected with a ladder placed vertically on rising ground on shore or on a light-house. The electric waves emanating are taken up by receiving apparatus on vessels having such within a radius of seven miles. A bell sounds and the receiver notes the spot against which vessels should be warned.

Electricity played a curious part in a recent lawsuit. A certain telegraph company was not allowed to have its wire run into a race course. Telegraphic operators were stationed in a cupola of a hotel opposite the grounds, and signals were transmitted to them from the race track by means of electric lights concealed in the hats of the party seated in a carriage, including the coachman on the carriage. The results of the races and the betting were thus communicated to the operators, who were enabled to send out the information to poolrooms. The gentlemen who were electrically equipped were arrested, and after some years a verdict of $5,000 was obtained against the detectives who made the arrest.

It has been proposed to erect at Dundee, Scotland, a granite monument over the grave of James Bowman Lindsay. He was born in 1799 and taught electricity, magnetism and other subjects in Dundee, where he died some forty years ago. In 1834 he foresaw that "houses and towns will in a short time be lighted by electricity instead of gas, and machinery will be worked by it instead of steam." This prediction was the result of his observations of the effects produced by the electric current, and not merely by dreaming. In 1854 he transmitted telegraphic signals through the water electrically, and when the British Association visited Aberdeen in 1859 he demonstrated the success of his method by sending signals across the harbor. He also read a paper entitled "Telegraphing Without Wires."

James D. Reid, an associate of Prof. Morse, died lately in New York city. He was born in Edinburgh, Scotland, and came to Canada in his sixteenth year. Later he went to Rochester, and while there became acquainted with Prof. Morse, the inventor of the telegraph. Mr. Reid was for a while associated with Prof. Morse in perfecting his invention, and then went to Pittsburg and opened the first telegraph office in that city. He was for a long time the superintendent of the old Ohio and Pacific Telegraph Company, which was afterward absorbed by the Western Union. While he was in charge of the telegraph office at Pittsburg, Andrew Carnegie, who was then a boy, applied to him for a position, and Mr. Reid set him at work as a messenger. Mr. Carnegie has often said that this was the starting of his successful career, and the friendship between the two men ceased only with Mr. Reid's death.

Considerable consternation has been caused in London by the announcement that dwellings along the route followed by the new electric railway are suffering severely from vibration caused by the running of the trains. In some instances it is stated that the houses are in a perpetual tremor, while the windows incessantly rattle. The chief center of complaint is near the West End terminus of the line, which is probably due to the fact that there is less vehicular traffic in the streets at this part of the city, thus causing the peculiarity to be more readily observed, and also that the line is brought somewhat nearer the street surface than elsewhere, though in this instance it is over 60 feet below the thoroughfare. An inquiry is to be made into the complaint, to ascertain the cause of such excessive vibration and whether it is possible to remedy it. When the bill for the construction of the railroad was brought before Parliament, it was contended that at that deep level no vibration would be felt at the surface. So far there appears to be no apparent reason for this extraordinary development, but until it has been thoroughly investigated, all other projects for similar railways will remain in abeyance.

Engineering Notes.

Five submarine boats of the Holland type are called for by the English naval estimates. Lord Selborne, First Lord of the Admiralty, states that their future value in naval warfare can only be a matter of conjecture. The first is to be delivered in the autumn.

The mysterious obstruction of Cape Thoms, Brazil, in 35 fathoms of water, which is placed on the British and American admiralty charts as a rock, turns out to be a large vessel, bottom up, held in position by her anchors and at times submerged.

Dr. Ludwig Mond has discovered a method for producing illuminating gas and coal gas at an expense of four cents per thousand feet. It is thought that this will effect a revolution by cheapening electric power, and it will also have an important bearing on the production of open-hearth steel.

There is a vast coal supply in Australia which is almost unworked as yet; the total product is so far about a million tons, and the larger part of this output has been from the Province of New South Wales. The resources of Victoria appear to be vastly greater. The Latrobe Valley produces lignite of good quality, and the supply is estimated at thirty billion tons. Shafts which have been sunk revealed beds 200 feet in thickness. It has been found that the Australian lignite was superior to the German in quality, and it also leaves less ash.

In the last maneuvers of the German army experiments were made with the acetylene light in optical telegraphy. Up to the present night messages and signals have been transmitted by means of the lime light. Acetylene, mingled with a certain amount of oxygen, was found to give a candle power three times greater than that of the lime light. By its means signals could be flashed by day to a distance of five miles and by night to a distance of ten miles. The simplicity of the apparatus employed in generating the gas is likewise noteworthy. Hitherto the signal corps has been compelled to transport the necessary oxygen in heavy cylinders. For the acetylene light oxygen is generated in fifteen minutes by means of a small retort and stored in a gas-bag.

A contract has been made for six new turbines by the Niagara Falls Power Company with the I. P. Morris Company, of Philadelphia. These new turbines will each have a capacity of 5,000 horse power, and will be built after plans prepared by Escher, Wyss & Co., of Zurich, Switzerland. Dr. Coleman Sellers, chief engineer of the Niagara Falls Power Company, and William A. Brackenridge, resident engineer of the same company, went to Geneva, Switzerland, about a year ago, and on their return the Niagara Falls Power Company invited competitive plans from Escher, Wyss & Co., the result of which is that their plans have been accepted, and the new turbines will be built after their design. The turbines installed in the present wheel-pit were designed by Piccard, Pictet & Co., of Geneva, Switzerland. The new turbines will differ considerably from the wheels now in use, principally in having the guides and buckets inclosed in the wheel case and having draft tubes which will allow the utilization of the full head of water available. The new turbines will be delivered about next August, and will be used to drive the six generators ordered in November last from the General Electric Company.

The construction of the Tehuantepec Railway and the harbor improvements at Coatzacoalcos and Salina Cruz, respectively, are proceeding apace. Mr. W. D. Pearson, the principal of the well-known British firm of contractors who are carrying out the work, has recently published an account of the work and the scope of the enterprise when completed. There is no doubt but that this new and practical pathway between the Atlantic and Pacific Oceans offers a serious menace to the Nicaraguan Canal. This firm of contractors have obtained a lease of the railway for 50 years. It is about 190 miles in length and crosses Mexico at its narrowest point. It was constructed some years ago by the Mexican government, but fell into partial disuse owing to its inferior construction and to the absence of terminal facilities for the shipping. Harbors, however, are now in course of erection with adequate wharves and quays equipped with the latest labor-saving machinery for the rapid loading and unloading of the vessels. Merchandise landed at one port will be unloaded, transported across the isthmus and reloaded at the other port at an inclusive cost not exceeding $2.50 to $3 per ton. The present carrying capacity of the Panama route is about 300,000 tons per annum, but it is anticipated that the lower rates, improved facilities, and better accommodation of this new route will divert the traffic thereto. The distance from New York to San Francisco by this new route will be about 700 miles shorter than by the Nicaragua Canal, and 1,100 miles less than by the present Panama road, while the advantage from New Orleans to San Francisco will be 1,600 miles over Panama. By this means the west coast will be brought within a much closer distance of the east coast.

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CONSTRUCTION OF THE YACHT "CONSTITUTION."

In the SCIENTIFIC AMERICAN of March 30 we gave a very complete description of the structural features of the cup-yacht "Independence," which was illustrated by drawings made from the working plans of that yacht. We are now in a position to present to our readers an equally complete and authentic set of drawings of the cup-yacht "Constitution," which latter, by the time this issue is in the hands of our readers, will have taken her first taste of salt water.

Two years ago the SCIENTIFIC AMERICAN printed the first working plans of the "Columbia"; and, by referring to the illustrations then given, it will be seen that if the sheer-plan of the new boat were laid upon that of its predecessor, they would approximate very closely. The "Constitution" is a high-powered "Columbia," with the same sheer plan, the same draft, a lighter hull, more lead, with exactly a foot more beam (not two feet as currently reported), with less dead-rise, a flatter floor, and a harder bilge. As the result of these combined improvements, all looking to the one object of increased power, she carries about 10 per cent, or about 1,300 square feet, more sail than "Columbia." Her dimensions are as follows: Length over all, 132 feet 6 inches; length on waterline at normal draft, 89 feet 9 inches; beam, 25 feet 2½ inches; normal draft, 19 feet 10 inches.

PRINCIPLES OF DESIGN.—Other things being equal, the fundamental object aimed at in the design of a 90-foot racing yacht is power, or the ability to carry a maximum amount of sail. This may be secured by changes of form, or by reduction or transposition of weights, or both. Increased power due to form is gained by increase of beam, by flattening the floor and "hardening" or filling out the bilges, thereby raising the center of buoyancy and placing the body of the boat more upon the surface of the water. Power due to form, however, is gained at the expense of sweetness of lines and ease of propulsion; hence the genius of the designer is shown in finding that happy mean which gives a maximum power with a minimum hardness of form. Thus, comparing the last three Herreshoff boats, "Defender" presents in her midship section the sweetest and most beautiful form ever seen in an American 90-footer, the bilges rounding in to the reverse curve of the garboards with the unbroken sweep of a letter S. In "Columbia" the floor is flatter, the beam is increased, the bilge hardens and the garboard curve is reduced. In "Constitution" the development has been pushed still further; there is even less dead-rise, there is a distinctly straight line in the floor, and the bilge is still harder than that of "Columbia." The results of this development, in terms of sail area are seen in the respective figures of 12,640 square feet for "Defender," 13,125 for "Columbia," and 14,400 for "Constitution."

Not all of this increased power is to be attributed, however, to form. Much of it is due to improved methods of construction, by which the same strength of spars and hull is secured with the use of less material. In a yacht of a given displacement every pound of weight that can be taken out of the rigging, spars or hull may be placed in the lead keel with a consequent increase in sail-carrying power. Thus we find that the ballast (that is, the lead keel and the loose pig lead for trimming of the vessel) has gone up from 85 tons in "Defender" to 90 tons in "Columbia," and as high as 93 tons in "Constitution." "Columbia" is a larger boat than "Defender" and probably is slightly heavier in construction; but as compared with "Columbia" the new boat, in spite of her greater beam and increased lead, will be of about the same displacement, a feat of construction for which the greatest credit is due to the designer.

RADICAL CHANGE IN CONSTRUCTION.—The considerable lightening of the hull of "Constitution" (which be it remembered, has been accompanied by a decided gain in strength) has been secured by a radical change in the method of framing. The usual system in yacht construction is to use shallow transverse frames, a few inches in depth, at intervals of 20 to 22 inches, throughout the whole length of the yacht. This is the system adopted in "Independence." It is this framing that holds the hull to form, by resisting the transverse bending and crushing stresses; while the longitudinal stresses are taken up by the plating, assisted by two or four lines of stringers, as the case may be, by far the greater part of the longitudinal strains, however, falling upon the plating itself. Hence the latter must be made of greater weight than is actually necessary to enable it to act as the mere skin clothing of the frames. Herreshoff's innovation consists in running the framing of the yacht in both directions, using deep belt frames of an I-beam section for the transverse system of framing, and associating them with a system of longitudinal T-bar and angle-iron framing, which serves at once to take up a large proportion of the longitudinal strains which ordinarily fall upon the plating, and so enables the weight of this plating to be very materially reduced. The transverse belt frames and the longitudinal framing are so arranged with regard to the width and lengths of the plating that the butt joints meet upon the frames, and the seams follow the longitudinal T-irons, thus doing away altogether with the weight of the washers and liners necessitated in riveting up a boat built in the conventional way.

Judged from an engineering standpoint, this is a far more scientific distribution of the material to meet the special strains to which the hull of a yacht is subjected, particularly in a seaway. Just how great is the saving in weight is shown by the fact that although the superficial area of the Tobin bronze plating on "Constitution" is greater than the superficial area of the bronze on "Independence," the sheer strake in the latter being of steel, the total weight of the bronze plating actually laid on the Boston boat is a fraction under 30 tons, while the total weight of the plating in "Constitution" is slightly under 22 tons. Moreover, it must be remembered that this difference of 8 tons may be put into the keel without calling for a pound more of displacement, or the increase of a single square foot of wetted surface. This is a clear gain due to good engineering; and surely the yacht designer who would dare to use 6-32-inch plating on the topsides of a 90-footer is entitled to all the gain in power and speed that are coming to him. Just here it may be well to state that no little of the credit of these successful results is due to that remarkable material Tobin bronze (the invention of a United States naval officer whose name it bears) which has come to be looked upon as an indispensable material for the plating of our American cup defenders. Not only does it take on a wonderfully smooth polish, but it preserves it indefinitely; while it has the further invaluable quality of showing a tensile strength in the test specimens that is only a few pounds under 40 tons to the square inch.

STRUCTURAL DETAILS.—The transverse belt frames, which are spaced 6 feet 8 inches apart, extend entirely around the hull and do duty at once as frames, floor plates, and deck beams. They are of I-beam section, the web from 5-40 to 6-40 of an inch thick and 15 inches deep amidships, the depth decreasing toward the ends, with flanges formed each of a pair of 1½ x 1½ inch angles. The belts are built up, as shown, in sections with a 2¼-inch lap at the joints riveted with a double row of ⅞ rivets. These beams, by virtue of their great depth, provide far greater stiffness than an equal weight of the shallow 4-inch bulb angles which are used in the conventional type of construction. "Constitution" is not the first yacht to carry these frames, as they were used experimentally in last season's 70-footers. Mr. Herreshoff has profited by that experiment; for in a jump of a sea off Newport the frames buckled, the inner flanges springing out of line; hence the presence of diagonal braces of 1⅛ inch pipe which extend, in pairs, from the longitudinal T-irons to the inner flanges of the belts. These struts, moreover, afford stiffness to the longitudinal framing of hull and deck.

The longitudinal framing consists of alternate 4½ x 4½ T-bars and 3 x 2 bulb angles. The T-bars follow the seams of the plating, which, in general, is 48 inches wide, and the angles are spaced midway between the T-bars. The belt frames are cut to allow these longitudinal frames to pass through, and the latter extend in unbroken lines from stem to stern, the ends of the T-bars being jointed with a U-iron splice, riveted to head and web of the bar as shown in the detail drawing, while the bulb angles are placed back to back, at the joints, and riveted. These longitudinal members being continuous and well riveted to the plating, it will be seen that they not merely keep the plating to shape, but also take a large share of the longitudinal stresses. Calculation of the weights of a given area of framing in "Constitution" and "Independence" shows that there is not much weight saved in the framing alone, but it must be remembered that, weight for weight, it is a much stronger construction. The saving is in the weight of the plating, which Mr. Herreshoff has lightened out to the extent, as we have seen, of eight tons, as compared with "Independence." Amidships there are seven strakes of plating. Commencing at the sheer strake, the thicknesses are 6-32, 6-32, 6-32, 7-32, 7-32, 7-32, and 8-32 inch. The first four strakes, to the top of the garboard strake, have flush seams; below this they are lap-jointed. The sheer strake extends above the deck line and is riveted to a 2 x 2 bulbed angle, whose head forms the rail of the boat.

THE FIN AND LEAD BULB.—From station 28 to station 50 the belt-frames are carried down into the fin and riveted to the keel-plate, which is a Tobin bronze casting, ½ inch thick by 18 inches wide, with 4-inch side flanges, and transverse flanges at every frame station. At the three frame stations in the fin, intermediate between each belt-frame floor-plate, is an angle-iron frame. Of these, the center frame is a 1¾ x 1¾ plain angle, and the other two are 1 x 3 bulb angles. Here again Herreshoff has made a considerable saving of weight; for instead of running the floor plates down to the keel, the frames are tied together merely by a 12-inch keel plate, and a 12-inch floor-plate, with a 1¾-inch square tie-rod midway between them. These floor-plates commence at station 11 and extend aft to station 63. The framed structure of the fin terminates, as we have seen, in a half inch bronze keel plate, and below this plate the 95-ton belt of lead is hung in the following manner: First, the lowest strake of the bronze plating is extended down to overlap the lead by 20 inches, the latter being rabbeted out to receive it. Through these plates 824 bronze tap-screws, ⅝ x 6 inches, are screwed into the lead, 412 on each side. The keel is further supported by thirty-seven 1 x 10 inch vertical lag-screws, which are screwed through the keel plate into the lead. If anyone cares to figure out the total section of the bronze bolts thus employed, he will find that there is an ample amount of holding strength, even should the "Constitution" experience a knock-down in a short, jumpy sea, when the dynamic bending moment at the junction of the keel and lead might easily rise to a total of 400 or 500 foot-tons.

THE MAST-STEP.—To provide the requisite strength at the mast-step (which, by the way, is placed 20 inches further aft than "Columbia's" mast) an extra belt-frame is introduced, there being a belt-frame at stations, 28, 30 and 32. The web of the frames is also increased to 7-40 of an inch. The step is formed by a combination of these frames with a deep keelson of 7-16 inch steel worked intercostally between the frames, from station 24 to station 36, the keel plate being increased to ⅝ of an inch in thickness beneath the mast and for the full length of the mast-step. The keelson increases in depth from frame 24 to frame 28, where it reaches a maximum of 4 feet 6 inches, which depth it holds from frame 28 to frame 32. From frame 32 it decreases in depth until it terminates at frame 36. The floor-plate portions of the frames 28, 30 and 32 carry the same depth as the keel plate. A ⅝ inch, double, cover-plate closes in the mast-step, and below the cover-plate extends a deep, hollow, cone of ⅝-inch plating which is riveted to the cover plate and the keelson. The upper flange of the cone consists of two 1½-inch angles, the outside diameter of the ring, formed by these flanges, being just 24 inches. The bottom of the steel mast will have riveted around it a 1½ inch angle-iron, with an outside diameter of 24 inches, and when the mast is in place it will be bolted down upon the cone by bolts which will pass through the ring on the mast and be made fast by nuts below the cone-ring. It is 6 feet 10 inches from the top of the step to the deck, and on each side of the mast-ring at the deck, intercostal plates are worked in between the belt-frames. The mast framing at the deck is stiffened against fore-and-aft racking strains by a trussing of hollow steel tubing, which extends in a fore-and-aft plane from the deck beams to the cover plate of the keelson. Three-inch tubular bilge struts extend from all the belt frames at the bilge to the same frames at the deck; but in the wake of the mast these struts are moved in to further assist in bracing the mast-ring and mast-step construction. The whole design is entirely novel, and shows the characteristic resourcefulness of the Bristol designer. It is extremely stiff and strong and gives evidence that Herreshoff has learned the lesson of the buckled mast-steps with which he was troubled in previous defenders. In one of these, a step which had a calculated resistance to crushing of 250 tons showed signs of buckling when the yacht was being sailed hard in the scend of a heavy sea. The deck is carried by the belt frames and by longitudinal lines of 1⅝ bulb angles, which latter extend in unbroken lines from stem to stern, passing through apertures cut for them in the belt-frames. Galvanized steel deck plating is used, and to protect it from the weather it is covered with a preparation of cork tiling which is impervious to water and at the same time adds but very slightly to the weight of the deck.

SAIL PLAN.—From what has been said of the lowering of weights in "Constitution" and the increased power of her form, it is evident that she can swing aloft a spread of sail which will rival that of "Independence" in area. Compared with "Columbia," the boom will be lengthened to 110 feet, about 4 feet will be added to the hoist, the fore triangle will be lengthened, as will the topmast and gaff, with the result that a total of 14,400 square feet of sail will be carried—an area which may be subsequently decreased or added to according to the ability of the boat as shown in her tuning up. All things considered, we look for "Constitution" to beat "Columbia" over a thirty-knot course by not less than ten minutes in light airs and five minutes in a breeze. This would mean an advantage of respectively eighteen minutes and eleven minutes over "Shamrock I." under the form which the latter yacht showed over here. Will "Shamrock II." display an equal superiority over "Shamrock I."?

It is gratifying to know that the new cup-defender will be under the management of William Butler Duncan, Jr., whose very able handling of "Defender" in the tuning-up trials of "Columbia" added greatly to the interest of the trial races of the season of 1899.

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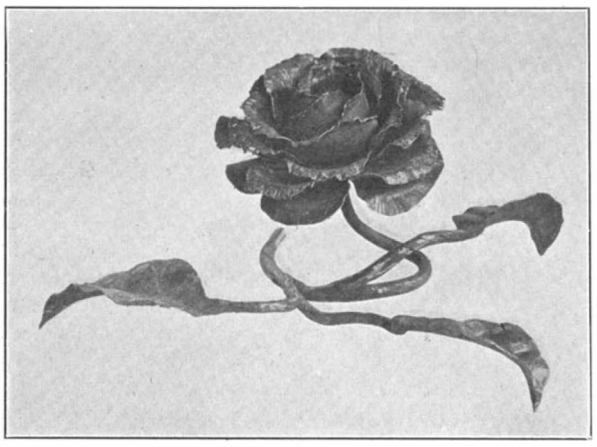
HOW TO MAKE AN IRON ROSE.

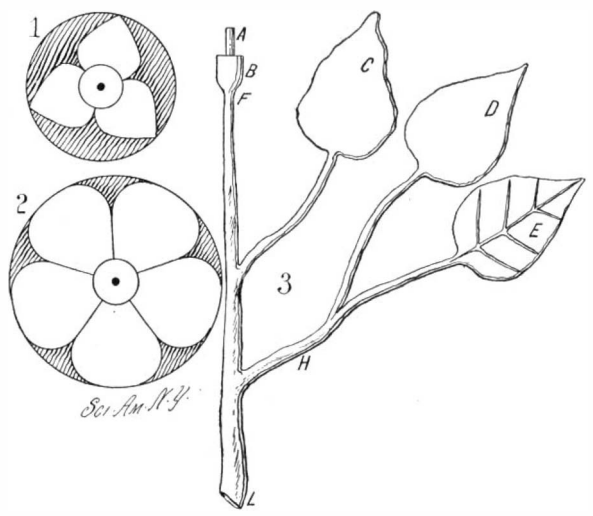
BY PARKER SIMONSON.

An iron rose is a very beautiful specimen of iron work which appears to be very difficult to make. It is, on the contrary, very simple and easy. It can be made by any boy who possesses a few common tools. The materials, costing only a few cents, can be bought in any city or village, or may even be found at home.

From a square foot of common sheet or stove-pipe iron, about No. 26, cut out one circular disk three and a quarter inches in diameter, three of three inches, one two and three-quarters of an inch, and one two inches. In the center of these draw a five-eighths-inch circle with a compass, and then cut the two-inch disk into three equal sections and the rest into five sections, remembering to cut down to the line made to the five-eighths-inch circle only (Figs. 1 and 2). Take the shears and cut the two-inch disks (Fig. 1) and the remaining disks (Fig. 2). Now punch a hole in the center of each to fit the neck, *A* (Fig. 1). With a ball-headed hammer strike the petals of the disks, having previously placed them on a piece of lead, until they are convex, and approach the center so that each will be convex. Take a cold chisel and draw its temper down to a dark blue, and then place it in a vise and round off the cutting edge with a file. Take one of the series of convex petals in the left hand and place about one-eighth of an inch of the outer edge on the rounded edge of the cold chisel and strike it with a hammer so as to spread the edge. Do this on the outer edges of all but the two-inch and one of the three-inch series of petals. The petals of the rose can now be laid aside until the rose-stem and leaves are made. A piece of three-eighths of an inch iron rod five inches long, also three pieces of one-quarter-inch iron rod five inches long are required. To form the leaves and rose-stem a forge will be necessary, but if the reader has not one he can doubtless get a neighboring blacksmith to allow him to work at his forge and anvil. To make the leaves, take the three pieces of quarter-inch iron rod and spread one end of each of the three pieces until it is about two inches long and one and a half inches wide; then draw the stems out to about an eighth of an inch in diameter and weld two of the stems together (see Fig. 3, *H*). To make the rose-stem, take the three-eighths iron rod and draw it out in the shape of *BL* (Fig. 3), allowing the part, *B*, to be about one-half of an inch long, and the part, *A*, to be three-eighths of an inch long. The part, *A*, should be filed down until it is about one-eighth of an inch in diameter. Take the remaining quarter-inch-stem and leaf, *C*, and weld it on to the rose-stem, *AL*, and then weld the part, *H* (Fig. 3), on to *AL*, but about two inches from the end of the stem, *L*. It would be best to use a little borax in welding the stems together, because they are very easy to burn; but if borax is used, it will enable the iron to join together readily at a lower temperature. To do the welding proceed as follows: When the iron rods are a bright red, rub them with some borax, which melts and adheres to the iron rods. Then put them back in the fire and proceed in the ordinary manner, only remembering that they have only to approach a white heat, when they will weld together. File the stems and leaves up smooth and then cut the irregular leaves up as shown at *D* (Fig. 3). When this has been done, put one-half of one of the leaves in a vise, and by striking it with a hammer turn the other half over, so that on looking lengthwise along the leaf it will look like a V. Then lay the edge of the leaf on the anvil and strike it with a hammer so that it will spread the leaf and make the ridge of the leaf curved. Put a few creases on each side of the leaves (see Fig 3, *E*) and after this is done attach petals to the stem, *A* (Fig. 3). To do this put the unspread three-inch petal on the stem, *A*, first, then the spread three-and-a-quarter-inch, then the two three-inch ones, then the two-and-three-quarter-inch, and lastly the two-inch. The petals should be forced down into place and then the stem, *A* (Fig. 3), should be struck with a hammer and flattened out so as to bind all the petals firmly together. With a pair of pincers



A HOME-MADE IRON ROSE.



BLANK FROM WHICH THE IRON ROSE IS FORMED.

bend and twist the two-inch petals so that they will form the little bud that is in the interior of the rose. The other leaves should be bent around this to suit the artistic taste of the maker. The lower three-inch disk should have its petals bent down as though drooping. The rose and leaves can now be bent so that it can be set down on a table and look artistic, and if it is desired to protect it from rusting it can be coated over with the following mixture, which is a dull black—drop black and turpentine; use it thin.

If the reader does not know anything about forge work, he can make the rose anyway, but he will have to omit the iron leaves, *C*, *D*, *E*, and substitute in their place some imitation leaves. He can make the petals of the rose as here described. For the stem, *AL* (Fig. 3), take a piece of three-eighths iron rod about six or seven inches long, and file it up into the shape shown in the engraving, and then put the leaves on as described above. Bend the stem into any desired shape, and then wind around it the stems of the imitation leaves and black it, and it will look very neat and attractive.

A DISAPPEARING TOWN.

Northwich, the center of the salt industry of Great Britain, is one of the queerest towns in the country. The whole underlying country is simply one mass of salt. When descending a shaft, one passes through successive thick strata of the mineral. The mining of the salt constitutes the staple industry of the district, and from Northwich alone 1,200,000 tons of salt are shipped annually. The product is obtained by two methods—quarrying and brine-pumping. In the former case, which is the method generally adopted, a shaft is sunk about 300 feet, and the salt rock blasted and excavated in the usual manner. The brine-pumping, although it is still continued upon a large scale, is gradually falling into disuse. When the industry was started it was considered that only one stratum of salt existed, and that was only a few feet below the surface. Fresh water found its way to this extensive salt deposit, with the result that the salt dissolved like snow. A huge subterranean lake of water, charged with 26 per cent of salt, was thus formed. Pumping engines were then installed to convey this brine to the surface to large evaporating pans, in which a heavy deposit of salt was left after the water had evaporated. The result of this extensive pumping is that Northwich now rests, as it were, upon a shell of earth, which at times proves insufficient to support the weight of the houses, with the inevitable consequence that the buildings are constantly sliding and collapsing in every direction. Our illustration conveys a very graphic idea of the magnitude of these subsidences and their effect upon public property. As the result of a subsidence, the building shown in our illustration fell over upon its back in the course of a single night, and it is noteworthy that the house, owing to the care observed in its construction, fell over intact, not a crack being produced in the walls nor even a pane of glass being broken. This is by no means a single instance. Throughout the town the same effects are to be observed upon all sides. There is scarcely a perpendicular wall to be seen; in numerous cases the doors and window frames of the houses are awry; the roads are extremely uneven, and are often closed, owing to the falling in of portions. Houses are being continually condemned as unsafe for human habitation and demolished. The depreciation of public property is enormous. No matter how substantially a house may be built, or how great the care observed to obviate subsidence, the building is bound to sink sooner or later. In one instance, a house that cost $30,000 to erect was shortly afterward sold for $7,500, it had been so injured by subsiding. In some cases the sinking is very gradual, while in others it is unexpected and instantaneous. One of the principal thoroughfares took forty years to sink fifteen feet, while another grew appreciably wider every day. Examination proved that one side of the street was slipping completely away. In this instance the foundations of the houses were three feet distant from the buildings which they originally supported. The shop of a dry goods merchant sank one-fifth of its height in ten years, and in the subsequent seven years subsided another fifth. Several houses may be seen, the windows of the ground floor of which are level with the roadway. It is no uncommon circumstance for a building to be constructed and have to be abandoned shortly after its completion.

A DISAPPEARING VILLAGE IN ENGLAND.

The inhabitants,

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however, endeavor to mitigate the danger of their buildings' collapsing by constructing them upon the frame principle, with massive timber beams securely bolted together. By this means if a subsidence occurs the house does not necessarily collapse, but heels over in toto. In this instance the house is raised to its normal position once more by means of jacks, the cavity filled in, and the building once more rests upon a firm foundation. Should another subsidence occur, the process of lifting is repeated. In the case of the subject of our illustration, however, the original house was so damaged that it had to be demolished and the ground prepared for the building depicted in our illustration. But it had not been built twelve months before another subsidence occurred, throwing the building into the position shown in the photograph.

Yawning chasms are constantly appearing in the streets, and in some instances the cavities are so extensive as to necessitate the closing of the thoroughfare.

The area in which these subsidences occur covers about two square miles. A few years ago the matter was brought before the attention of the British Parliament, and the result of their investigations showed that damage had been inflicted upon 892 buildings, of which total 636 comprised houses and cottages. Some idea of the extent of the excavations in this area may be gathered from the fact that as a ton of salt represents one cubic yard, and 1,200,000 tons of salt are produced every year, therefore 1,200,000 cubic yards of solid material underlying the town is removed annually.

The water from the river also gravitates toward these subsidences, causing huge inland lakes, which aggravate the danger. One of these lakes, locally called "flashes," covers no less than 100 acres and varies from 40 to 50 feet in depth.

Notwithstanding the frequency of these subsidences and that they are often unexpected, strange to say not a single life has been lost. Havoc has been wrought among cattle, however, several animals having been completely engulfed. The tall shafts of the pumping stations are also another source of danger, since they are gradually thrown out of plumb, the list continuing until the stack heels over, burying and destroying everything in its path.

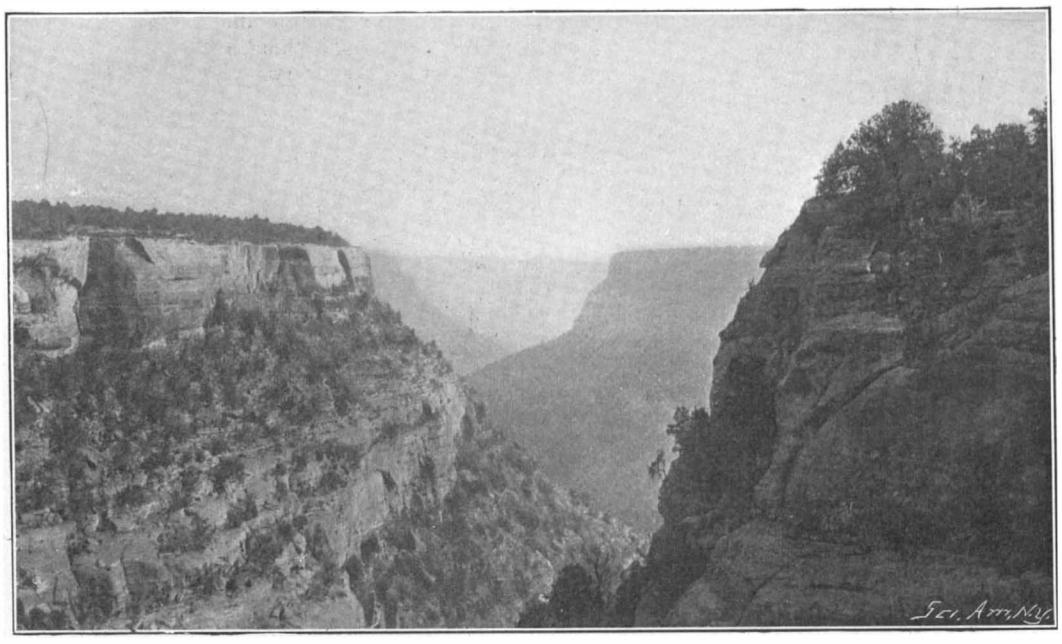
A few years ago a compensation board was founded. This corporation levies a tax of six cents upon every ton of brine that is pumped to the surface, the revenue derived from this source being devoted to compensating those unfortunates whose property has been damaged by subsidence.

In an article by M. G. L. Bourgerel, in the Moniteur Scientifique, the author states that by using an acetylene blowpipe, and a suitable supply of oxygen, temperatures approaching those of the electric arc can be readily obtained. It seems, however, that undiluted oxygen must not be used, or there will be a deposit of carbon and other troubles. By experiment the proportion of oxygen and air can readily be found, under these conditions the acetylene burns with a slightly luminous, but intensely hot, flame, which, by varying the relative proportions of oxygen and air, is made either oxidizing or quite neutral.

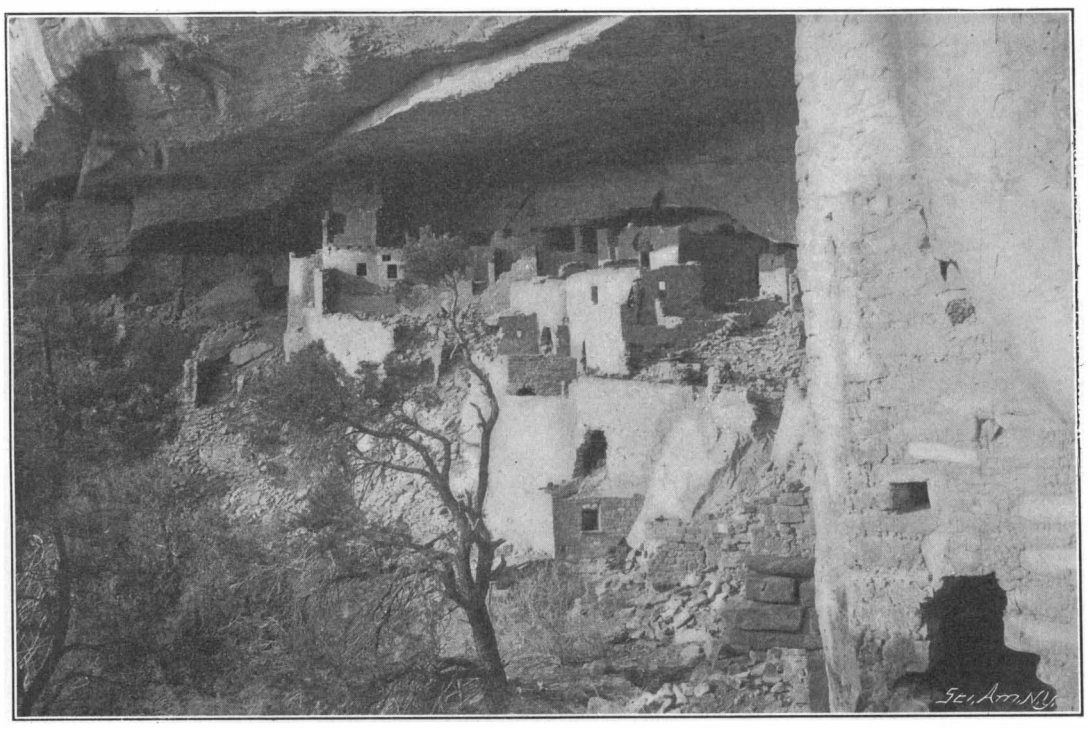
A CLIFF-DWELLING PARK IN COLORADO.

BY COSMOS MINDELEFF.

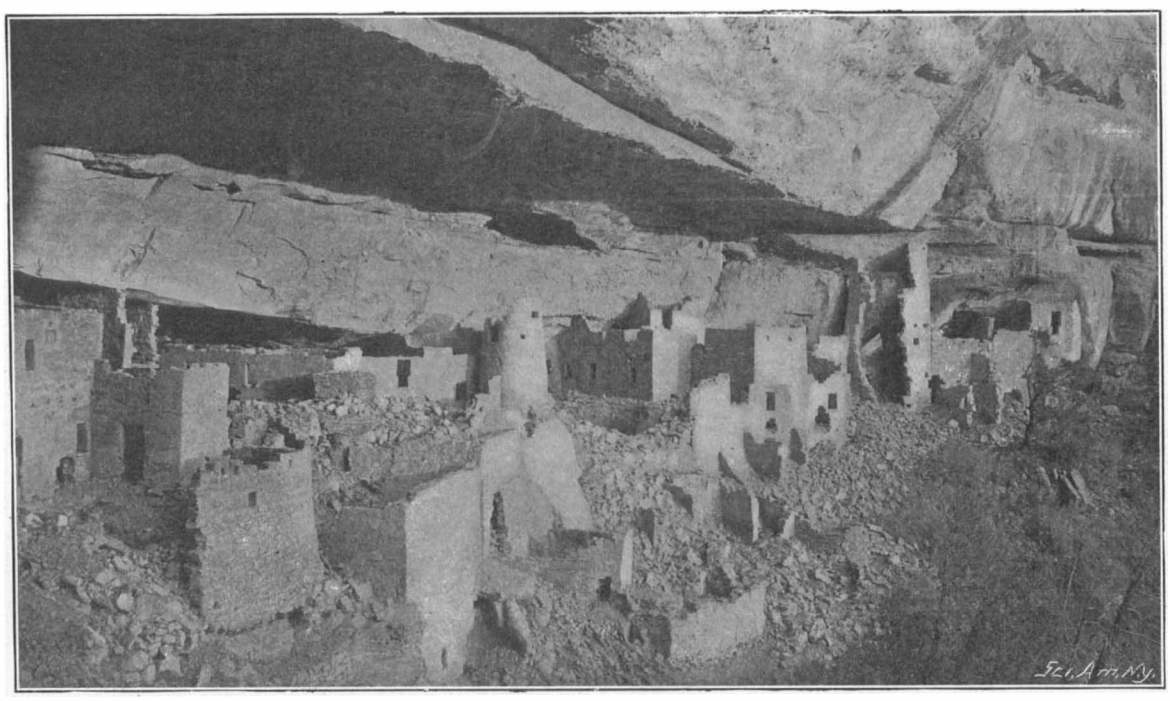
Action by Congress in the closing days of the session which ended March 4 last renders certain the preservation of the most interesting cliff ruins in this country, and their protection from further spoliation. The region known as the Mesa Verde, in Colorado, in which there are hundreds of ruins, is to be set aside as a public park, and steps are to be taken to put a stop to the commercial exploitation of the works of the ancient cliff dwellers.



VIEW DOWN CLIFF CAÑON.



RUIN IN CLIFF CAÑON FROM SOUTH END.



RUIN IN CLIFF CAÑON FROM NORTH END.

Discovered some twenty-five years ago, the ruins on the Mesa Verde and in the Mancos Cañon, which cuts through the heart of the elevated tableland, rested for a long time undisturbed and even unvisited, owing to the inaccessibility of the place. Within the past ten years, however, ranchmen living in the vicinity found that specimens from the ruins had a commercial value, and active work began on the stripping of the remains of everything which could be carried off. Under the Act of Congress this destruction will soon cease. The Mesa Verde is an elevated tableland of the type which characterizes southwestern Colorado and northern New Mexico and Arizona. It is irregular in form, comprising about seven hundred square miles, approximately flat on top, but cut into innumerable cañons and gorges by the Mancos River and its tributaries. The great development of the art of building among the ancient cliff dwellers was due in a large measure to the peculiar geological features of the country, nowhere better illustrated than in the Mesa Verde.

The Mancos Cañon is about thirty miles long and from 1,000 to 2,000 feet in depth, the narrow, irregular river bottom being bounded by long, steep slopes of débris, which merge into a succession of steeps and slopes, culminating above in a series of lofty cliffs. Traces of the old cliff dwellers are to be found throughout the region, along the bottoms, in the cliffs, and on the high tablelands. Taken altogether, there is no region which surpasses the Mesa Verde country in its archæological interest, or which is better worth preservation, although it should be noted that the Indians have a tradition of another and better region to the south.

Practically all the more important types of ancient dwellings are represented in the remains found in the Mesa Verde region, and, in addition, there are others which reach a development there not attained elsewhere. Even the large valley settlements, comprising several hundred rooms, and located without reference to defense, the highest type of the ancient builders' architecture, are found here and there in favorable sites on the canyon bottom.

These valley settlements merge almost insensibly into the cliff dwellings proper through another type which might be termed cliff villages, a type which appears to have reached its highest development in the Mesa Verde region. One of the most imposing of these cliff villages, discovered in comparatively recent times, is a ruin which has been called the "Cliff Palace," found in the upper part of Cliff Cañon, one of the principal gorges which join the Mancos Cañon from the north. The ruin is 425 feet long and occupies a cove in the cliff about 80 feet high and about the same in depth. Some of the rooms were circular, some oval in shape, but most of them were rectangular, and in places the structure was at least three stories high. Access to the settlement could be had only from above, by the aid of a series of steps cut into the face of the cliff. Eight miles above the mouth of the Mancos there are the ruins of another large cliff village. In this case the houses occupied two narrow ledges in the cliffs, one about thirty feet above the other, and at least 800 feet above the cañon bottom.

The cliff villages always contained one or more circular rooms, the use of which was doubtless religious, for similar structures are found in the valley ruins

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and in some of the inhabited pueblos, where they are known as estufas. In them are performed many of the most sacred ceremonies of the tribe. Besides the cliff villages, however, there are hundreds of cliff dwellings in the Mancos Cañon and its branches, ranging in size from single rooms up to groups of considerable importance, in which no circular rooms are found. Many of them are on sites so inaccessible that it seems incredible that human beings should select such places for homes.

A type closely related to the cliff dwelling proper is the cave dwelling, fine examples of which are found in the Mancos Cañon and in other parts of the region. These curious habitations are hollowed out of the cliffs by digging away the soft shaly rock and then walling up the fronts. In one place in the Mancos Cañon a picturesque outstanding promontory is literally honeycombed with these dwellings, which give one the impression that they were constructed by a race of pygmies, for neither the outer apertures nor the openings between the rooms are large enough to permit a person of ordinary stature to pass through.

On the brink of the cliff above these cave dwellings is the ruin of a circular tower. These towers are found throughout the Mesa Verde country; in fact, there is hardly a half mile without the remains of one or more of them. Nowhere else do they attain the same development. In size they range from ten feet in diameter up to forty or more, with walls one to two feet in thickness still standing, in some cases to a height of over fifteen feet. They are invariably connected with other structures, usually groups of rectangular rooms, and in the finest examples the circular walls are double and even triple, the spaces between them being divided into apartments by partition walls of lighter construction. The masonry is of the highest type, the stones being dressed on the outside of the curve by pecking with a stone implement, and laid neatly in mud mortar.

It has been suggested that the circular towers were in some way connected with the peculiar rites of serpent worship, and perhaps were the repositories for the snakes used in the sacred ceremonies. In the Moki villages, to the south, where the snake dance is a biennial rite, all that part of the ceremony which precedes the public exhibition takes place in the estufas, and if the same rites prevailed in the Verde country, as seems likely, it is probable that they were performed in the circular towers.

Throughout the whole of the Verde region, in favorable localities, there are dozens of pictographs, both pecked into the rock and painted upon it. That many of these were executed by the people who built and lived in the houses now in ruins there can be no doubt. The figures are engraved or cut into the face of the rock, which has been chipped out to a depth of a quarter of an inch or more. One of the most striking groups is about six feet long, and consists of a procession of men, birds, and beasts, a general movement to the right being shown. The figures appear to be tied together in a continuous line, with smaller figures, perhaps representing dogs, above and below, while a number of men are stationed on either side as if to keep the procession in order. Doubtless the artist of long ago, who must have devoted months to his work, sought to represent some event of the highest importance to his tribe, perhaps a migration or a victory over some other people.

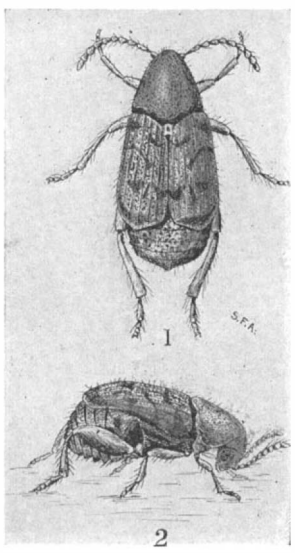
The illustrations are from photographs by Mr. F. H. Chapin, of the Hartford Archæological Society.

THE BEAN WEEVILS.

BY S. FRANK AARON.

There are few insects that when infesting materials useful to man cannot be easily detected at all times. Only the wood borers, and certain weevils in grain, etc., are hidden during the larval stage, and the pea and bean weevils are particularly unobservable. The pea weevil attacks its chosen food only in the green, rarely, if ever, breeding in dried peas. The bean weevils breed for generation after generation in dried beans, so riddling them in time that they become a mass of holes, perhaps, indeed, more holes than beans. A recent and considerable infestation of dried beans may be detected by the somewhat dirty appearance, caused by the beetles and young larvæ cutting into the beans. When attacking green beans, there is not, except under almost microscopic examination, any evidence of the work. There are only small cuts in the pod where the eggs are deposited and minute holes where the just-hatched larvæ have bored through into the beans. So it often happens that the little weevils within are cooked or canned along with the beans and eaten all unsuspectedly. But need we really care, if such is the case? The little larva or pupa, full of nothing but bean food, is so much bean itself that it is certainly doubtful if the epicure could distinguish between a mess of bean weevil larvæ and a mess of uninfested beans similarly cooked.

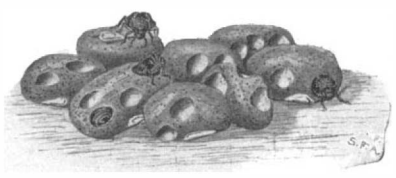
The bean weevils, common and very destructive in the United States, are of two species, belonging to the family Bruchidæ. They are allied to the snout beetles, or true weevils, the Curculios. *Bruchus quadrimaculatus* is reddish or mahogany brown with four large black spots on the wing covers and other black markings. *Bruchus obtectus*, called also *B. fabæ*, is slaty brown with somewhat obscure darker markings. The beetles of both species average about one-eighth of an inch in length. The habits of both are similar. The female cuts a slit in a green pod or dry bean and lays an egg therein, depositing many eggs thus in suitable places, but rarely more than one or two to



BRUCHUS OBTECTUS.

1. Dorsal View. 2. Lateral View.

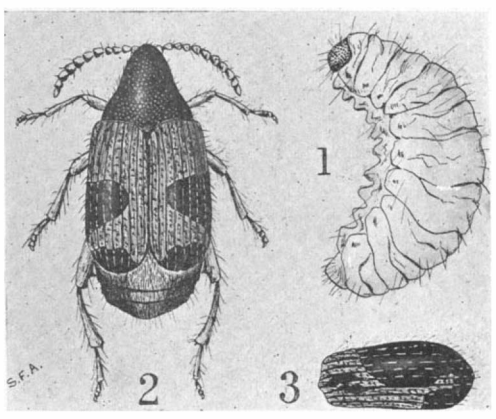
each seed. The larva hatches soon after, and at once bores its way into the bean, filling the hole behind it rather loosely with its cuttings. Thence its tunnel grows larger and larger to accommodate its increasing bulk and appetite. When full grown, and the better to permit the subsequent beetle to force its way out, the larva bores to the inner surface of the thin skin of the bean, leaving that intact for the protection of its transformations. Then it changes into the pupa stage and later into the fully developed beetle, which on emerging cuts open the thin, semi-transparent skin at the end of the burrow and escapes, leaving the boring exposed. Beans with holes are a sure indica-



THE WORK OF WEEVILS IN BEANS.

tion of having been infested by this insect. Sometimes in the very large varieties of beans several holes, the work of one generation, may be observed.

Little has been ascertained as to the means of checking the ravages of this insect. There is no sure way by which they can be prevented from attacking growing beans. Insecticides are here valueless. But when the insects are found in dry beans they can be killed and general infestation prevented by fumigation with carbon bisulphide in tight bins or barrels, or by subjecting the beans to a dry heat of about 150 deg. F. for several hours. Infested beans cannot be successfully used for planting as they produce sickly plants,



BRUCHUS QUADRIMACULATUS.

1. Larva. 2. Beetle, Dorsal View. 3. Wing Cover.

and when a general infestation has taken place the beans had better be burned or effectually destroyed, thus rendering subsequent crops less in danger of attack.

Opening of the Pan-American Exposition.

The Pan-American Exposition opened quietly on May 1, without the usual ceremonies, which are reserved for the formal dedication on May 20. In a short time the Exposition will be entirely completed, and even at the present time the showing is an interesting one. In connection with the Exposition, we have opened a new office in Buffalo, Room 577, Ellicott Square Building, which is in charge of Mr. F. J. Wagner, our advertising representative for the Central States. All manufacturers and advertisers are requested to call upon Mr. Wagner at some time during their sojourn in Buffalo.

Our Special Pan-American Edition.

There is no doubt that the Pan-American Exposition at Buffalo this summer will attract thousands of travelers and buyers from Spanish-America and even from such distant lands as Japan, China and India.

Recognizing that these travelers could be benefited by a species of guide, which would give the various routes of travel to and from their homes and Buffalo, we have decided to issue a special number of our Export Edition in the early part of June, devoted to the interests of this Exposition along the lines already indicated.

As soon as our intention became known, we found that such a special edition would be most acceptable throughout the countries reached by our Export Edition. So hearty have the responses been to our tentative efforts that we can confidently assure our advertisers that the circulation of this special number will be at least double the present and already large circulation of our Export Edition. We believe that advertising in this issue will bring most excellent results, inasmuch as each copy reaching the hands of influential importers and buyers abroad will be kept as a ready reference guide to the Buffalo Exposition, and will therefore become a directory of American manufacturers advertised in its columns.

Our advertising pages have already felt the effects of our first essays at securing advertising on the strength of this special edition, and we urge our patrons and intending advertisers to secure the space in this edition as soon as possible, as, owing to the large number of copies to be issued, as well as the large amount of advertising matter to be handled, we expect to be obliged to close our forms at an earlier date than usual. For this one issue, we will allow advertisers to sign contracts for one insertion at special rates, to be furnished on application, either from our agencies or directly from this office.

We hope that many manufacturers who do not make a practice of advertising in regular publications will make a trial of one insertion in this special edition as we feel confident that the large circulation which will be given to their advertisement will be conducive to their using the advertising columns of our publication regularly thereafter.

We should be pleased to enter into correspondence on this subject with all manufacturers interested, and ask their co-operation, with any suggestions which they may think advisable for such a special edition.

The Current Supplement.

Among the articles in the current Supplement, No. 1323, which should be of interest are a biography of America's Nestor of engineers, Charles H. Haswell; an article on the "Prospects of Automobiling," by M. C. Krarup, and an account of Suter's airship, in which the inventor nearly lost his life. "A Petroleum Turbine" is the title of an illustrated article which should be of no small value to those interested in the development of the explosion-engine. In his description of the "Great Salt Lake," Prof. Ralph S. Tarr tells much that is not generally known. Some curious animals provided with queer teeth are described by Mr. R. Lydekker in an article on "Living Millstones." Inspector Rice P. Steddom has much valuable information to convey pertaining to the cattle of Porto Rico. "Destructive Insects and Insects as Etiological Factors in Disease" is the title of a lecture delivered by Prof. Henry Skinner, M. D. Illustrations and an account of a process of long-distance radiography are also presented in the Supplement. Prof. Charles F. Holder tells, in an interesting way, something of the way in which Californians move large palms. The usual consular notes, formulas, etc., will be found in their customary places.

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RECENTLY PATENTED INVENTIONS.

Bicycle Appliances.

PEDAL.—ISAAC A. BRADDOCK, Haddonfield, N. J. The pedal is a combined "rat-trap" pedal and ordinary swinging pedal. The swinging member is to be used when the roadbed is uneven, very muddy or obstructed by loose sand, and when the bicycle is running on an upgrade. The increased leverage afforded by the swinging members of the pedals enables the rider to propel his machine easily. On a good roadbed the rat-trap combination is used.

Mechanical Devices.

COMBINED COTTON-PLANTER AND GUANO-DISTRIBUTER.—SIMEON S. CUDD, Kelton, S. C. This combined cotton-planter and guano-distributer is a very simple and practical seed-planter. Although specially designed for planting cotton-seed the machine can also be used for other kinds of seed. The fertilizer-distributer is completely under the control of the operator, so that the guano can be controlled and cut off at will.

PROCESS OF SEPARATING GARLIC FROM WHEAT.—JACOB K. SCHEIRER, Northampton, Pa. When wheat is harvested, the garlic growing among it is still green and the seeds are pulpy and juicy. Both garlic and wheat are threshed together before the garlic seeds have become entirely dry. The garlic juice forms a glutinous glaze on the wheat and communicates a garlic odor to the grain. Moreover, many unbroken garlic seeds of the same size and weight as the wheat kernels are delivered to the miller, for the reason that they cannot be removed by an air-blast. The present inventions effects the complete removal of the garlic seeds, whereupon the grain cuticle is removed, so that flour obtained by grinding the wheat has no trace of garlic.

MECHANICAL TOY.—JOHN W. MACKIN and JULIUS ZWEIGART, Chicago, Ill. The mechanical toy represents a monkey walking on the top of a rolling ball. When the ball rolls along the monkey appears to walk on top of the ball, especially as the several joints of his body are loosely connected and hence are free to vibrate with the ball.

CLUTCH-PULLEY. — CHARLES NEWSOM, Portland, Colo. On the shaft a sleeve is splined, loosely carrying the pulley. Clutch members are mounted on the sleeve at each side of the pulley, one of the clutch members having connection with the sleeve to be moved therewith. A connecting member works between the other clutch members and the sleeve to press the parts and cause both clutch members to engage the pulley.

Vehicles and Their Accessories.

HORSELESS CARRIAGE.—ENRIQUE SANCHIS, Madrid, Spain. The invention is a horseless carriage which belongs to that class in which the motor is mounted on a fore-carriage. The novel features of the invention are a running-gear having on each side driving ground-wheels mounted to rotate upon axes capable of swinging about vertical pivots, and motors mounted to swing with the wheels in their steering movement and having their drive-shafts located centrally of the wheels.

COMPENSATING GEARING.—JOSEPH F. KRAMER and JOHN H. BLUM, Gunderson, Mont. The compensating gear is particularly adapted for wheeled vehicles, the object being to permit the rotation of the two opposite traction wheels at different rates of speed while turning corners. On adjacent ends of two sections of a shaft ratchet-wheels are mounted. A sleeve surrounds these ends of the shaft sections, in which sleeve the ratchet-wheels are arranged. Double-arm pawls coact with the ratchet-wheels, and are in turn acted upon by springs. On the sleeve a driving-wheel is mounted.

Railway Contrivances.

AUTOMATIC MAIL-BAG CATCHING AND DELIVERING APPARATUS. — CHARLIE E. LOCKE, 1,202, 12th Street, Louisville, Ky. Mr. Locke has invented a very simple and ingenious apparatus which includes an automatic mail-bag catcher arranged on a postal-car and another catcher arranged and suspended outside of the track. The invention includes trustworthy means for suspending and automatically releasing and catching mail-bags on cars and at stations in general.

SPARK-ARRESTER.—LARKIN L. CRUMP, Westpoint, Miss. Within a casing an inner shell or drum is fitted, converging toward its upper end and having openings in its lower end. Discharge-flues communicate with the lower end. Between the drum and casing are guides, converging toward their respective outlet openings. A steam-pipe within the drum and casing is provided with steam-discharge openings. A separating wheel is journaled upon the steam-pipe between the openings and above the inner shell or drum. The wheel discharges the sparks or cinders outwardly so that they will be thrown out of the current of heat and will drop between the casing and the drum. The steam extinguishes the sparks.

Miscellaneous Inventions.

SNATCH-BLOCK.—GUSTAVE AMUNDSON and JESSE E. KNIGHT, Blue Canon, Wash. This invention is an improvement in snatch-hooks which are made to open automatically by fastening or forming on the rope which is used with the block, an enlargement of some kind which, upon engagement with the block, will throw open the movable check and permit the rope to run off the block.

SASH-LOCK. — JOHN H. GRACEY, Westfield, N. Y. This improved sash-lock and window-fastener securely fastens the sashes together when the window is either closed or open for ventilation and when the sashes are open to prevent either being moved.

COMPOSITION FOR REMOVING BOILER-SCALE. — BENJAMIN PEÑA, Laredo, Texas. The boiler-scale compound consists of an extract of the plant *Larrea Mexicana*, which extract is added to the water in the boiler. The solution prepared and used as directed by the inventor is said to prevent reincrustation without any effect whatever on the metal of the boiler.

FINGER-RING.—JOSEPH L. HERZOG, Manhattan, New York city. This finger-ring is constructed so that a stone or gem can be securely or removably held in place. The stone is removed inwardly and the fastening or holding devices are invisible from the outside of the ring, so that in outward appearance the ring does not differ from those of ordinary construction.

MEANS FOR APPLYING SOLDER TO METALLIC ARTICLES.—EMILE BESSE and LOUIS LUBIN, Rue d'Angoulême 93, Paris, France. The lid or bottom of a can previously suitably shaped either with a groove around its periphery or with a flange has a number of small holes punched in its periphery, and upon its inner face is laid a circular or oval ring of soldering metal. The ring of solder is preferably so crushed or compressed as to form a groove into which the edge of the body of the can fits so that a proper position is maintained.

GAME-TABLE.—SYLVESTER B. COMSTOCK, La Colorado, Mexico. The table is provided with a pit or pits into which dice may be passed while playing a game, so as to be in plain view of the person acting as counter for the game. The table has a rim to prevent the dice from rolling off, the rim being removable to permit the cleaning and repairing of the table.

FOLDING CATAFALQUE. — ADOLPH M. SMITZ, West Depere, Wis. This collapsible catafalque comprises two main parts or frames and a series of connecting frames which are hinged to and adapted to fold into the spaces in the main frames, so that the entire device can be readily stored away in a small space.

QUILTING-FRAME. — SIDNEY S. RUSSELL, P. O. Box 193, Memphis, Tenn. The end frames of this quilting-frame can be folded into a compact form and can be readily operated to secure and tighten the lining and cover of the quilt.

HAIR-FASTENER.—LOTTIE BASSETT, Cedarville, Cal. The patent describes a clamp which can be attached to the hair when braided and serve not only to tie the hair tightly and prevent its unbraiding. but also to carry a ribbon or bow, so that the ribbon may be permanently attached to the clamp. The necessity of frequently tying and untying the ribbon is thus avoided.

CLASP.—CLARA A. BARROWS, Bethel, Vt. The clasp is designed to hold the ends of shoe strings, and is composed of a body portion provided with a yielding tongue, and a clamping member hinged on the body portion and provided with a yielding tongue coacting with the tongue of the body portion, and also having a finger designed to engage a part of the body to hold the clamping member in engaged position.

PLATE FOR USE IN STEREOTYPING.—FREDERICK A. RINGLER, Manhattan, New York city. By means of this plate, half-tone line-etched engravings or duplicate electrotype plates are securely held in position in the matrix while the metal for forming the stereotype plate is poured into the mold. The plates are secured in their proper position in the stereotype plate to form integral parts thereof.

SHOW-CASE.—FRANK J. and JOHN A. BANK, Manhattan, New York city. The construction of the show-case is such that the side rails of the door are concealed by the corner posts or uprights of the body of the case, thus permitting the glass in the door to extend to and within the inner vertical edges of the corner posts. A maximum of display surface is obtained.

BOUTONNIERE.—THOMAS L. MCCORMACK, Danville, Ark. The invention is an artificial boutonnière which has a device representing a bird movable in and out of the flower and under the control of the person wearing the boutonnière.

SHAFT AND JOURNAL THEREFOR.—FRANK M. KENNEDY, Clarendon, Ark. Heretofore in mounting tubular shafting much difficulty has been experienced in adjusting the journals. To overcome this difficulty a conical journal and a body portion of a semi-circular contour integral therewith have been devised.

Designs.

RING.—CHARLES P. GOLDSMITH, Manhattan, New York city. The leading features of the design are two opposing buffalo heads on the upper periphery of the ring.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Business and Personal Wants.

READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send your name and address to the party desiring the information. **In every case it is necessary to give the number of the inquiry.**

MUNN & CO.

Marine Iron Works. Chicago. Catalogue free.

Inquiry No. 551.—For compound engines for launches of about 5 and 10 by 8 or 6 and 12 by 10 inches.

"U. S." Metal Polish. Indianapolis. Samples free.

Inquiry No. 552.—For plant protectors of waterproof paper, 15 to 18 inches high and 15 to 18 inches broad, for keeping frost from tomato plants.

WATER WHEELS. Alcott & Co., Mt. Holly, N. J.

Inquiry No. 553.—For dynamos for a private plant.

Yankee Notions. Waterbury Button Co., Waterb'y, Ct.

Inquiry No. 554.—For manufacturers of rubber flooring.

Turbines.—James Leffel & Co. Springfield, Ohio, U.S.A.

Inquiry No. 555.—For parties in Canada to make a three-piece metal novelty.

Dies & Special Machinery. Amer. Hdw. Mfg. Co., Ottawa, Ill.

Inquiry No. 556.—For manufacturers of small brass tubing known as hollow wire.

Sheet Metal Stamping: difficult forms a specialty. The Crosby Company, Buffalo, N. Y.

Inquiry No. 557.—For manufacturers of model engine castings, marine and stationary.

Sawmill machinery and outfits manufactured by the Lane Mfg. Co., Box 13, Montpelier, Vt.

Inquiry No. 558.—For manufacturers of steam brickyard apparatus.

Our number 4 Catalogue of Automobile parts, write us, Standard Welding Co., Cleveland Ohio.

Inquiry No. 559.—For manufacturers of agate marbles.

Rigs that Run. Hydrocarbon system. Write St. Louis Motor Carriage Co., St. Louis, Mo.

Inquiry No. 560.—For wholesale dealers in harness.

SAWMILLS.—Variable friction feed. Send for Catalogue B. Geo. S. Comstock, Mechanicsburg, Pa.

Inquiry No. 561.—For manufacturers of novelties.

FOR SALE.—Patented invention, "Nut Lock." S, Koralewski, 19 Eagle Block, 20th Street, Pittsburg, Pa,

Inquiry No. 562.—For the present address of the Aluminium Novelty Mfg. Co.

Foundry Machine, Pattern and Blacksmith shop for sale. Address M, Box 772 SCIENTIFIC AMERICAN.

Inquiry No. 563.—For parties to make lamps in quantities.

Ten days' trial given on Daus' Tip Top Duplicator. Felix Daus Duplicator Co., 5 Hanover St., N. Y. city.

Inquiry No. 564.—For manufacturers of apparatus for sleight of hand tricks.

Kester Electric Mf'g Co's, Self-fluxing solder saves labor, strong non-corrosive joints, without acid, Chicago, Ill.

Inquiry No. 565.—For oil heating and cooking stoves for use with crude oil.

Inventions developed and perfected. Designing and machine work. Garvin Machine Co., 149 Varick, cor. Spring Sts., N. Y.

Inquiry No. 566.—For ¼ inch seamless steel tubing, with bore of hole ⅛ and ⅜ inch.

For sale and introduction in Scandinavia, of American goods, any and all. Apply to O. P. Jespersen and Sonner, Copenhagen, Denmark.

Inquiry No. 567.—For Ferris or pleasure wheels about 40 or 50 feet for fair grounds or street fair use.

FOR SALE cheap, in perfect condition, SCIENTIFIC AMERICAN and SUPPLEMENT, 1894 to 1900 inclusive. J. Elliott Shaw, 632 Arch Street, Philadelphia.

Inquiry No. 568.—For parties to make a barrel similar to a common sugar barrel, made of clear basswood without knots, and to be grooved like washtubs.

The celebrated "Hornsby-Akroyd" Patent Safety Oil Engine is built by the De La Vergne Refrigerating Machine Company. Foot of East 138th Street, New York.

Inquiry No. 569.—For manufacturers of round wooden boxes with screw tops for mailing purposes.

The best book for electricians and beginners in electricity is "Experimental Science," by Geo. M. Hopkins. By mail, $4. Munn & Co., publishers. 361 Broadway, N. Y.

Inquiry No. 570.—For manufacturers of spooling fishing reels, also parties who make spiral gear to fishing reel.

Sheet Metal Novelties, Articles and Stampings of all sizes. Tools and dies manufactured on contract. Address Standard Stamping Co. Cor. 7th & Hudson Sts., Buffalo, N. Y. U. S. A.

Inquiry No. 571.—For manufacturers of X-ray plants for hospital work.

WELL DRILLERS.—St. Landry Oil and Mineral Co., Opelousas, La., will receive proposals until May 20, for drilling oil well. Bond required and usual rights reserved. St. Landry Oil and Mineral Co.

Inquiry No. 572.—For manufacturers of asphalt mastic mixers.

Government Relics—guns, swords, revolvers, saddles, cannons, etc, from Government Auction are now being sold at ridiculously low prices. Send for illustrated lists. Francis Bannerman, 579 Broadway, N. Y.

Inquiry No. 573.—For manufacturers of sand driers.

WANTED.—An experienced specification writer and patent expert having a thorough knowledge of the patent practice and preferably one competent to handle electrical cases. Munn & Co., Solicitors, Office of SCIENTIFIC AMERICAN, 361 Broadway, New York.

Inquiry No. 574.—For a second-hand, one horse water motor or gas engine.

☞ Send for new and complete catalogue of Scientific and other Books for sale by Munn & Co., 361 Broadway, New York. Free on application.

Inquiry No. 575.—For a manufacturer of metal novelties to make a small mechanical typewriter eraser (automatic).

Inquiry No. 576.—For manufacturers of automatic fire sprinklers.

Inquiry No. 577.—For manufacturers of machinery for making wood screws.

Inquiry No. 578.—For manufacturers of furnaces for burning oil.

Inquiry No. 579.—For manufacturers of glass "stars" for holding photographs.

Inquiry No. 580.—For manufacturers of pocket match safes with a hinge on the side and shut at the end.

Inquiry No. 581.—For a lathe having a 6-inch swing and 12 inches between centers being a foot power lathe, but also do screw cutting.

Inquiry No. 582.—For manufacturers of steam toys.

Inquiry No. 583.—For manufacturers of electric cauterizing instruments.

Inquiry No. 584.—For manufacturers of a small ice plant of about 2 tons capacity.

Inquiry No. 585.—For the manufacturer of the "Kitchen Ice Machine."

Inquiry No. 586.—For manufacturers of aluminium numbers and letters.

Inquiry No. 587.—For manufacturers of water motors for pumping pipe organs.

Inquiry No. 588.—For sod cutters.

Inquiry No. 589.—For special files, 1⅜ inches long by ⅞ inch wide by three thirty-seconds inch thick.

Inquiry No. 590.—For a water still, filter, fountain pen, invalid's chair, watch, artificial diamonds, etc., for the mail order business.

Inquiry No. 591.—For a friction electric machine, such as the Holtz, Voss or Wimshurst, for experimental purposes.

Inquiry No. 592.—For a manufacturer or dealer in square gilt wire such as is used in making letters and pins.

Inquiry No. 593.—For manufacturers of tools for repairing pianos, harmoniums and other musical instruments.

Inquiry No. 594.—For machinery for making cloth circles such as are used in making cheese.

Inquiry No. 595.—For the manufacturer of a receiving box for spice and sugar grinding mill.

Inquiry No. 596.—For manufacturers of railroad and boat spike machines.

Inquiry No. 597.—For manufacturers of chains for the transfer of power similar to a bicycle chain with a sprocket.

Inquiry No. 598.—For small dynamos for 10 or 12 lights.

Inquiry No. 599.—For the present address of the Linney Air Churn Co.

Inquiry No. 600.—For wholesale dealers in laundry and toilet soaps.

Inquiry No. 601.—For the present address of the metal polish "The Yankee Cleaner."

Inquiry No. 602.—For a gasoline burner with a cap 6 or 7 inches in diameter.

Inquiry No. 603.—For manufacturers of cotton-threading machines.

Inquiry No. 604.—For manufacturers of an apparatus for feeding crude petroleum into furnaces.

Inquiry No. 605.—For manufacturers of the "straight-way" generator for party line telephones.

Inquiry No. 606.—For waste paper receptacles, flatted at the side so as to take up less space against the wall.

Inquiry No. 607.—For dealers in racks or gears, either new or second-hand; in New England preferred.

Inquiry No. 608.—For information as to the "French Tailor System" and the "Paris Glove Fitting Machine."

Inquiry No. 609.—For a spring motor machine which can be operated by one man.

Inquiry No. 610.—For manufacturers of wooden spigots with locks.

Inquiry No. 611.—For manufacturers of permanent magnets.

Inquiry No. 612.—For manufacturers of machinery to make portrait frames.

Inquiry No. 613.—For parties to make hoisting machines and clamshell buckets.

Inquiry No. 614.—For an engine with a capacity for running a small ice machine of about 5 tons daily, also with sufficient power to run a small laundry (washing machine).

Inquiry No. 615.—For machinery for small laundry complete.

Inquiry No. 616.—For complete machines for making ice, of about 5 tons daily capacity.

Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(8182) J. J. R. asks: 1. About what is the proper amperage and voltage of an open arc? A. The open arc has a drop of about 45 volts in it. Such a lamp, if rated at 2,000 candles, has 10 amperes flowing through it. 2. How many candle power per watt, and how is it rated? A. A 2,000-candle lamp is one which consumes 450 watts as defined by the National Electric Light Association. This gives a little over 4 candles per watt. 3. At what ratio with each other should the two carbons be consumed (direct-current arc)? A. The positive carbon wastes about twice as fast as the negative. 4. Could you recommend a good treatise devoted entirely to the arc light and the different systems; also issues of the SCIENTIFIC AMERICAN? A. Crocker's "Electric Lighting," Vol. I.; "The Generating Plant," price $3. Vol. II. is soon to be out. This will be a standard work. SUPPLEMENTS 1047 to 1052, six numbers, at ten cents each, contain a series of articles on the arc lamp. We also recommend SUPPLEMENTS 694, 695, and 696. 5. Could I double the power of the motor described in December issue by making the field and armature ring twice as wide and not change the number of turns or number of wire? A. You may do so. 6. If I increase the num-

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ber of coils on an armature and not change the other dimensions, is it necessary to have an uneven number. A. The number of coils may be odd or even. 7. About what is the voltage of the motor? A. A current from one storage cell will run the motor. This has a pressure of 2 volts. 8. In charging a storage battery having on positive and negative plates red lead, is it necessary to reverse the charging current at each charge for the first few charges to form the plates? A. The charging current is reversed to and fro until the plate is formed.

(8183) W. J. L. asks: Will you please inform me of a simple motor that will have power to run a baby carriage, to have the commutator bars on the axle, that the speed can be increased or decreased, simple as a fan, that will take as small space as possible, and if brass will do as well as copper for the commutator, and if a storage battery will be better than any other as to the expense, strength and weight? A. There is no motor whose armature rotates as slowly as the wheels of a baby carriage; so if the armature of any existing motor were attached to the axle of a baby carriage the nurse would need a trolley car to enable her to keep up with her charge. You will have to design a special motor for the service. Brass will not answer as well as copper for commutator bars, since it is not as tough as copper. You would almost of necessity use a storage battery to run the motor, since no primary battery will last as long and give so little trouble in maintaining it.

NEW BOOKS, ETC.

THE COPPER HANDBOOK. By Horace J. Stevens. Author's edition. Houghton, Mich. 1900. 8vo, paper. Pp. 328.

This little volume is intended for a work of reference on the mines of the lake copper district of Michigan, whose annual profits, when active, are greater than those of any other mining district in the world with the single exception of the Witwatersrand in South Africa. In this region are situated the famous Calumet and Hecla mines, together with many others of interest. Full particulars and data regarding all these mines will be found in this volume, as well as geological and miscellaneous notes on the subject.

HIGH-SPEED STEAM ENGINES. By W. Norris and Ben. H. Morgan. 114 Pp. 115 illustrations. London: P. S. King & Son.

This little volume forms a practical handbook of modern steam engine practice. Thirty-five modern high-speed engines of English and American make are illustrated and described, and tests are inserted wherever accurate ones were obtainable. These descriptions are prefaced by a helpful chapter on the development and operation of this type of engine; and the book concludes with a description of the De Laval and Parsons steam turbines.

INDEX OF INVENTIONS

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APRIL 30, 1901,

AND EACH BEARING THAT DATE.

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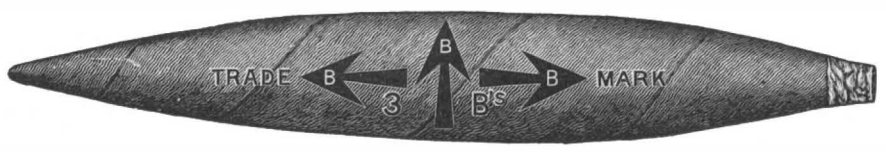

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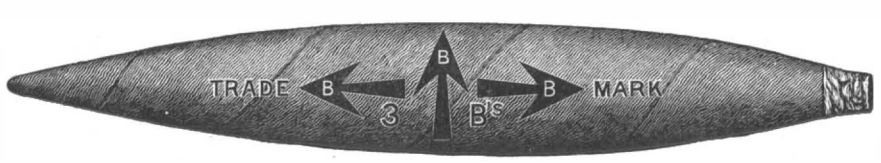

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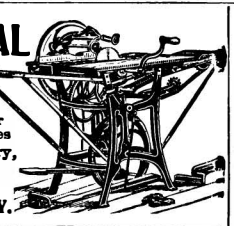

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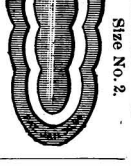

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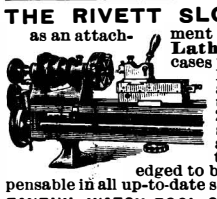

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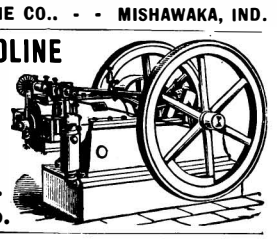

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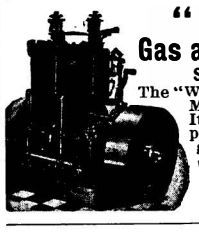

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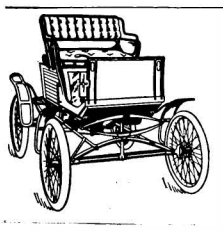

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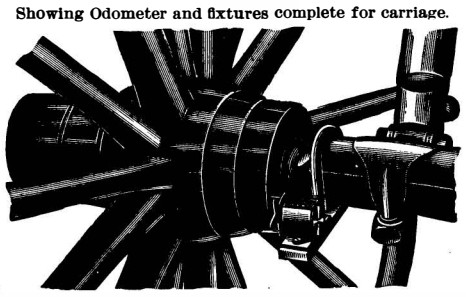

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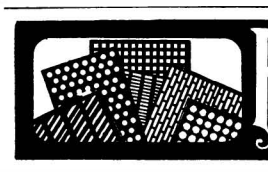

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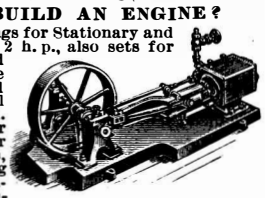

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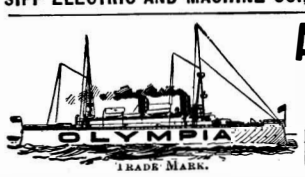

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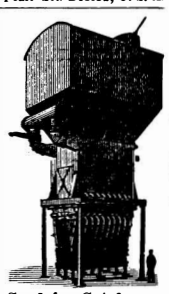

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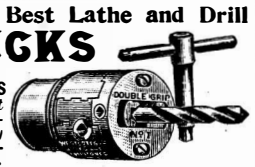

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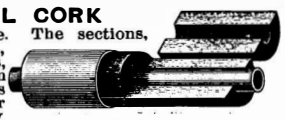

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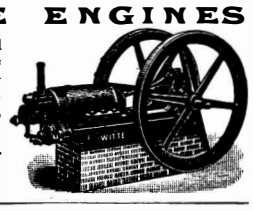

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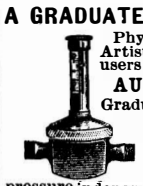

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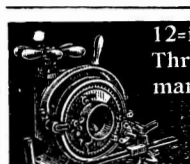

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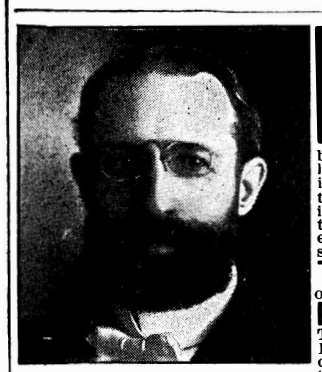

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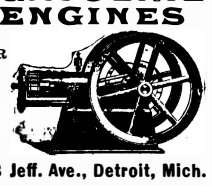

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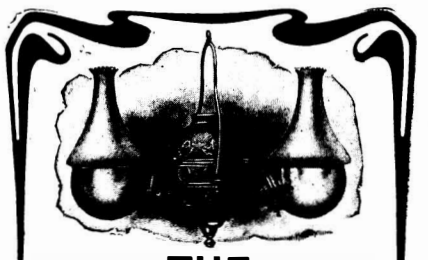

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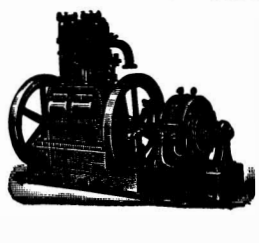

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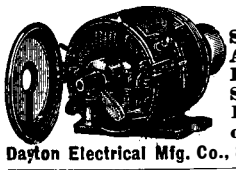

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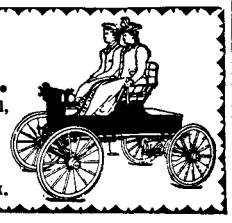

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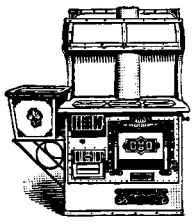

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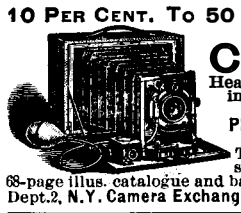

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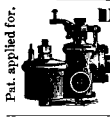

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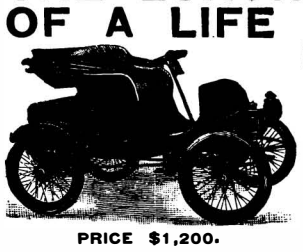

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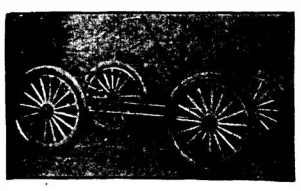

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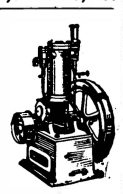

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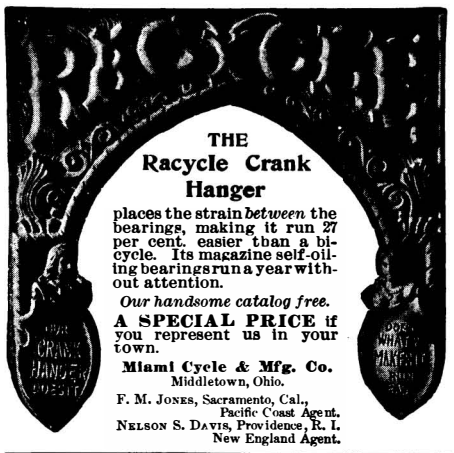

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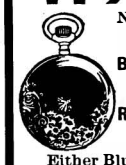

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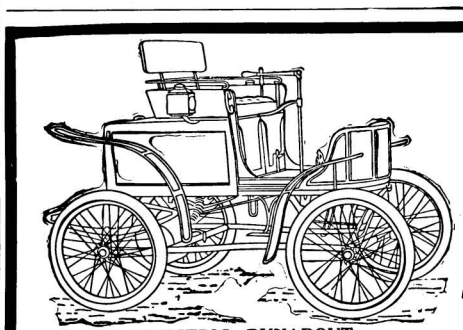

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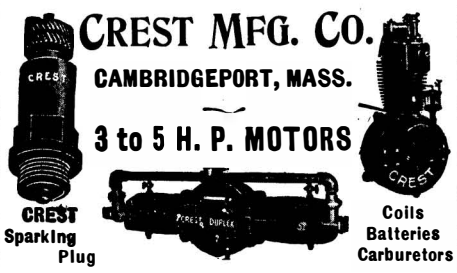

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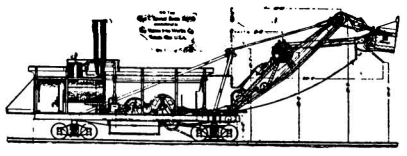

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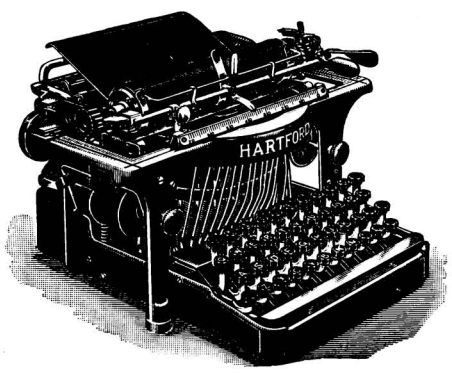

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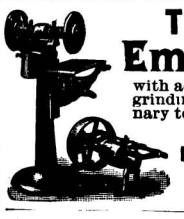

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